NATIONAL ENERGY BOARD

REASONS FOR DECISION

In the Matter of an Application under the National Energy Board Act

of

Interprovincial Pipe Line (NW) Ltd.

March 1981

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INTERPROVINCIAL PIPE LINE (NW) LTD.

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RECITAL AND APPEARANCES

IN THE MATTER OF the National Energy Board Act and the Regulations made thereunder, and

IN THE MATTER OF an application by Interprovincial Pipe Line (NW) Ltd. for a Certificate of Public Convenience and Necessity under Part III of the National Energy Board Act, and for an Order under Part IV thereof respecting rates, tolls and tariffs, filed with the Board under File No. 1755-J1-42.

HEARD IN Edmonton, Alberta on:

7, 8, 9, 10, 14, 15, 16, 17 and 31 October 1980 and

IN Yellowknife, Northwest Territories on:

20, 21, 22, 23, 24, 25, 27, 28 and 29 October 1980, and

IN Ottawa on:

4, 5 and 12 November 1980.

BEFORE:

R.F. Brooks	Presiding Member
J. Farmer	Member
J.L. Trudel	Member

APPEARANCES:

J.B. Ballem, Q.C. Richard Smith	for Interprovincial Pipe Line (NW) Ltd.
H.V. Page	for the Alberta Chamber of Resources
D. Nickerson	for Amoco Canada Petroleum Company Ltd.
F.J. Bregha A. Lucas D.J. Gamble	for the Canadian Arctic Resources Committee
M. Betts	for Chieftain Development Co. Ltd.

M.A. Ballantyne		for the City of Yellowknife
J.A. Olthuis		for the Committee for Justice and Liberty Foundation
S.T. Goudge J. Bayly	))	for the Dene Nation
R. Salter R. Herman R. Justus J. Simonetta	))))	for the Dene Tha' Band
J.E. Lowman E. Ryan	))	for Esso Resources Canada Limited
C. Donahue		for Foothills Pipe Line (Yukon) Ltd.
J.G. Gilmour S. Johnson R. MacPherson	)))	for the Government of the Northwest Territories
F. Hasey		for the Hay River Area Economic Development Corp.
E. Ryan		for Imperial Oil Limited
R. Hill		for the Inuvik and District Chamber of Commerce
S.T. Goudge J. Bayly R. Mercredi	)))	for the Métis Association of the Northwest Territories
J. Blackstock		for the NWT Grade Stamping Agency
J.B. McWilliams		for Rainbow Pipe Line Company Ltd.
D. Northrop A. Pluim	))	for the Town of Inuvik
A. Bigué K.J. MacDonald A.R. Macdonald	)))	for the National Energy Board

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ABBREVIATIONS

For Names

Act	-	National Energy Board Act
Applicant, IPL(NW) or Interprovincial (NW)	-	Interprovincial Pipe Line (NW) Ltd.
Band	-	Dene Tha' Band
Board	-	National Energy Board
CAGPL	-	Canadian Arctic Gas Pipeline Limited
CARC	-	Canadian Arctic Resources Committee
CJL	-	Committee for Justice and Liberty Foundation
CSA	-	Canadian Standards Association
COPE	-	Committee for Aboriginal People's Entitlement
DINA	-	Department of Indian Affairs and Northern Development
Esso Resources	-	Esso Resources Canada Limited
Foothills	-	Foothills Oil Pipe Lines Ltd.
Foothills (Yukon)	-	Foothills Pipelines (Yukon) Ltd.
GNWT	-	Government of the Northwest Territories
Imperial or Imperial Oil	-	Imperial Oil Limited
IBP	-	International Biological Program
IPL Interprovincial	-	Interprovincial Pipe Line Limited
Métis Association	-	Métis Association of the Northwest Territories
1972 Pipeline Guidelines	-	Expanded Guidelines for Northern Pipelines

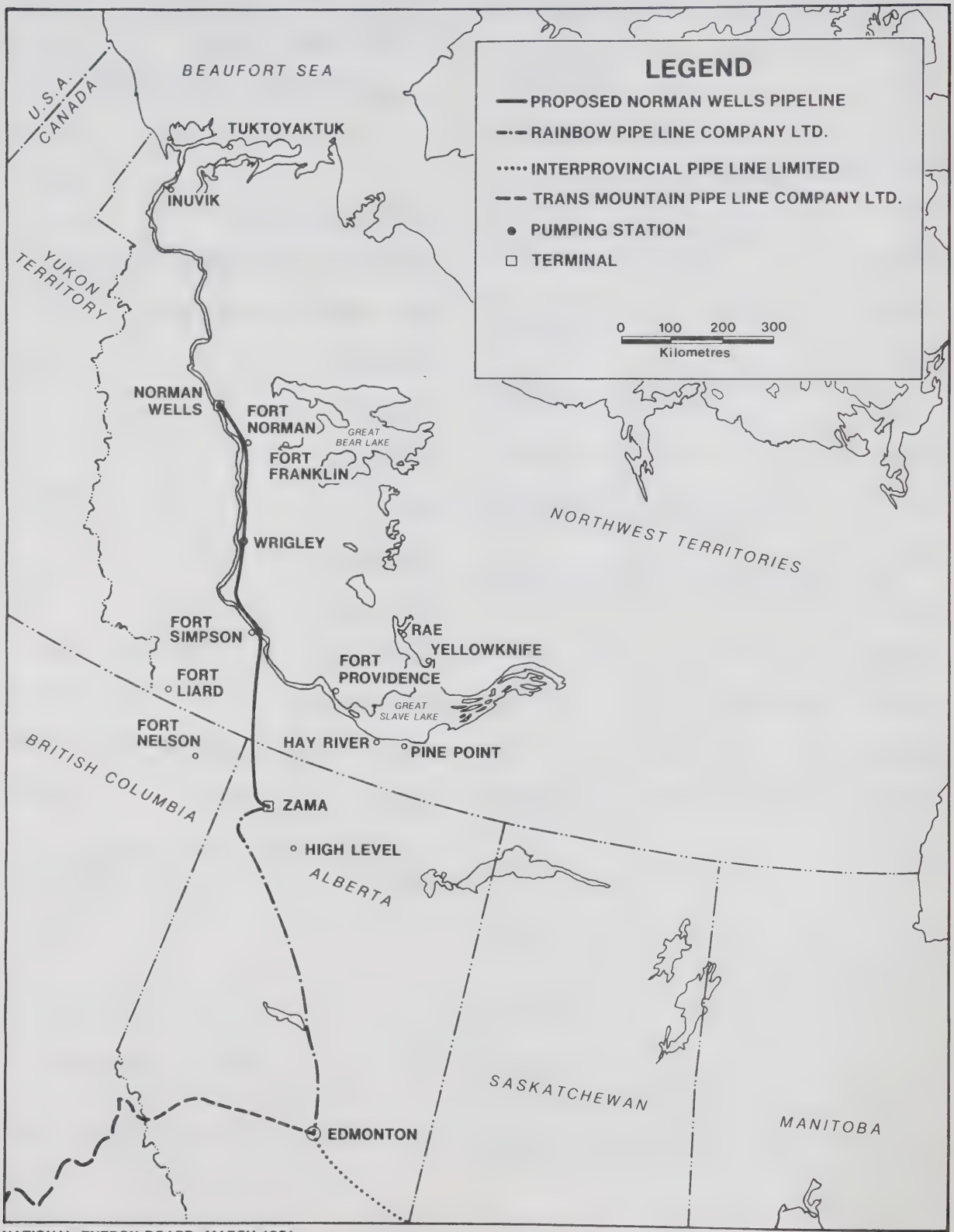
Rainbow or Rainbow Pipe Line	-	Rainbow Pipe Line Company Ltd.
Regulations	-	Regulations Respecting Oil Pipelines (SOR/78-746) 28 September 1978
U.S.	-	United States

For Technical Terms

°C	-	degrees Celsius
ERW	-	electric resistance welding
HVP	-	high vapour pressure
km	-	kilometre
kmp	-	kilometre post
kW	-	kilowatt
m	-	metre
m^3	-	cubic metre
m^3/d	-	cubic metre per day
mm	-	millimetre
mPa	-	millipascal
NGL	-	natural gas liquids
OD	-	outside diameter
W/m°C	-	watts per metre per degree Celsius

FIGURE 1.2

INTERPROVINCIAL PIPE LINE (NW) LTD.



NATIONAL ENERGY BOARD, MARCH 1981

DWG. No. 1141-M

CHAPTER 1
THE APPLICATION

1.1 The Applicant

Interprovincial Pipe Line (NW) Ltd., a company incorporated under the Canada Business Corporations Act, is a wholly-owned subsidiary of Interprovincial Pipe Line Limited, and is a company within the meaning of the National Energy Board Act.

1.2 The Application

The application, dated 14 March 1980, is for a certificate to construct and operate a buried oil pipeline 323.9 mm in diameter and extending some 866 km in length from Norman Wells in the Northwest Territories to Zama in northern Alberta. The proposed pipeline would be used to transport crude oil and natural gas liquids produced by Esso Resources Canada Limited from the expansion of its facilities at the Norman Wells oil field to existing Canadian markets.

The proposed pipeline system, with an estimated capital cost of $360 million, would comprise three pumping stations and all receiving, delivery and other facilities necessary to provide an initial designed capacity of 5000 m^3/d. The installation of additional pumping stations could raise this capacity to approximately 7150 m^3/d.

The route of the proposed pipeline from Norman Wells to Fort Simpson would follow the east bank of the Mackenzie River and would use already cleared rights-of-way for much of its length. South of Fort Simpson the proposed pipeline would cross the Mackenzie River and would run in a southeasterly direction to Zama where it would connect with the existing facilities of Rainbow Pipe Line Company Ltd. Figure 1.2 is a map showing the proposed pipeline system.

The application states that, based on the receipt of necessary governmental and regulatory approvals in 1980, the Applicant planned to have the pipeline completed and in operation in the fourth quarter of 1983.

The Applicant also applied for an order establishing the form and content of the rates, tolls and tariffs for the transportation service it would perform.

CHAPTER 2
INTERVENTIONS

2.1 Summary of Written Interventions

The following is a summary of the written interventions filed with the Board. Views of intervenors concerning specific topics are presented more fully in subsequent chapters of this report.

Alberta Chamber of Resources: an organization of more than 300 resource companies, intervened in favour of the application as the joint projects of IPL (NW) and Esso Resources would offer many tangible economic and social benefits for Canada and the affected region.

Amoco Canada Petroleum Company Ltd.: intervened in the proceedings as a major producer of oil and gas in Canada.

Canadian Arctic Resources Committee: an independent national association of citizens promoting the balanced development of the Canadian North, opposed the application at this time since, in its view, it does not meet the federal government's 1972 Pipeline Guidelines and prejudices the aboriginal claims of the native people of the Mackenzie Valley. CARC stated that the application failed to demonstrate that the Applicant has sufficient knowledge to build and operate the proposed pipeline in an environmentally and socio-economically acceptable manner.

Moreover, CARC submitted that the federal government has a moral and legal obligation to settle the aboriginal claims of the native people of the Mackenzie Valley before allowing the project to proceed.

Chieftain Development Co. Ltd.: a company engaged in the exploration, development and production of natural gas and oil, supported the proposed pipeline project.

City of Yellowknife: stated that the purpose of its intervention was to address the matter of development in the North and its socio-economic impact on Yellowknife and the North in general.

Committee for Justice and Liberty Foundation: a national public interest group, opposed the application as the proposed pipeline would adversely affect the socio-economic and environmental well-being of CJL members, all Canadians and, by extension, the well-being and basic rights of the native people of the western Arctic.

Dene Nation: an organization of the aboriginal people of the Mackenzie Valley, opposed the application. It believes that the proposed pipeline would have extreme and irreversible adverse effects on the social, economic and environmental well-being of its people.

The Dene Nation stated that approval of the application would not be in the public interest and was contrary to the public convenience and necessity while the settlement of land claims between its people and the Government of Canada remained unresolved.

Dene Tha' Band: representing native people living in the project's impact area in northern Alberta, anticipated that the construction of the proposed pipeline would result in a reduction of economic activities in the traditional resource harvesting patterns of its members. This would be due to disruption of the land and waters traditionally used by it for trapping, hunting, fishing and gathering.

The intervention stated that, without commitments and guarantees for employment and business development opportunities to offset the loss of traditional economic activities, the Band foresaw (a) an increase in the proportion of its population dependent upon federal government transfer payments, and (b) increased demands on the Band government to

provide goods and services, which would make it more difficult for it to realize its developmental goals and plans.

Esso Resources Canada Limited: operator of the Norman Wells oil field, fully endorsed the application and, subject to regulatory approvals for the project, was planning substantial investments to further develop the Norman Wells field.

Foothills Oil Pipe Lines Ltd.: a Canadian company formed for the purpose of transporting crude oil, including that found in Alaska and in northern Canadian frontier areas, requested intervenor status as the results of the IPL (NW) application could have a bearing on future decisions regarding the transportation of other American and Canadian northern petroleum reserves to southern markets.

Foothills Pipelines (Yukon) Ltd.: a Canadian company engaged in the transportation of natural gas, including that found in northern frontier areas, intervened on the basis that the results of the IPL (NW) application could have a bearing on future decisions regarding the transportation of other northern petroleum reserves to southern markets.

Government of the Northwest Territories : identified five issues it wished to address concerning the application, namely:

(1) that no framework existed whereby the Government of the Northwest Territories may receive an identifiable share of the federal royalties generated by the development of non-renewable resources in the Northwest Territories;
(2) that the application did not indicate an increase in energy supply to the local population on completion of this project;
(3) that there is a lack of any comprehensive long-term plan for the development of renewable and non-renewable resources in the Northwest Territories by the federal government;

(4) that there is no northern-based authority, planned or in existence, which can effectively control and regulate the development of non-renewable resources and at the same time represent the interest of the people of the Northwest Territories; and

(5) that to date there has been no satisfactory resolution of the oustanding claims for the aboriginal rights of the Dene Nation or the Metis Association.

Hay River and Area Economic Development Corp.: intervened in favor of the Norman Wells project.

Imperial Oil Limited: an intended shipper of crude oil and natural gas liquids from the Norman Wells field, fully endorsed the application.

Inuvik & District Chamber of Commerce: outlined several reasons for the support of an early decision for the implementation of the project. One reason stated was that there would be direct economic benefits for local residents through employment, business opportunities, and spin-off effects.

Metis Association of the Northwest Territories: intervened as a representative of the aboriginal peoples of the Mackenzie Valley not covered by the Indian Act, or the terms of Treaties 8 and 11.

Minister of Energy for Ontario: stated that the Province of Ontario favoured a national policy designed to achieve crude oil self-sufficiency at an early date. Moreover, the development of Canadian crude oil reserves and their connection to the interprovincial transportation system would be in the public interest, provided the project could be built and operated without unacceptable social and environmental impacts.

NWT Grade Stamping Agency: an organization promoting the interests and protection of the rights of those engaged in the forest industry within the Northwest Territories, gave its conditional support to the project provided that local businesses would be protected and afforded an opportunity to participate.

Rainbow Pipe Line Company Ltd.: a company which operates a pipeline for the transmission of crude oil from Zama to Edmonton, Alberta, intervened on the basis that the construction of the proposed pipeline would have a direct impact on the volumes of crude oil transmitted through its facilities.

Town of Inuvik: stated that a motion in support of the Norman Wells oil field expansion and pipeline construction (Motion 80-2512, dated 26 August 1980) had been adopted unanimously by the Town Council. One main reason stated in support of the application was that the project could increase employment, investment and business opportunities for Northerners. Moreover the project could act as a catalyst to promote northern developments and to provide a needed boost to morale in an economically depressed area of Canada.

Village of Fort Simpson: stated that it was conditionally in favour of the application.

CHAPTER 3
NORMAN WELLS SUPPLY

3.1 History and Background

The Norman Wells field was discovered in 1920; however, production did not commence until 1932 when a pilot topping plant was built. The 2500-hectare field, located onshore and underneath the Mackenzie River, first produced from wells on the mainland. Later, production facilities were installed on Bear and Goose Islands. Currently, production from these islands is barged to the mainland in summer and in the winter is transported *via* a temporary pipeline laid on top of the river ice. Since the major portion of the field lies under the river, it is largely undrilled.

The Norman Wells oil field is in a limestone reef which is tilted to the southwest. The reef has two main depositional environmentas, the reef margin and the reef interior. Currently, there are 70 producing wells at Norman Wells, but usually only about 44 are producing at any one time. The oil flows to the surface without assistance from pumping facilities, and some of the wells on Goose Island have produced at rates in excess of 60 m^3/d for extended periods of time. Generally, wells located on the reef rim or in areas of thick carbonate sands with good primary and secondary porosity have about twice the production capability of reef interior wells. Cumulative production to date amounts to about $3.7 \times 10^6 m^3$ and daily average production approximates 477 m^3/d.

The gas-oil ratio has gradually increased over the years. At present, the production of 303 m^3/d of crude oil results in the production of approximately 162 000 m^3/d of natural gas. This gas, rich in natural gas liquids, is currently being flared with only a small percentage consumed locally.

A local refinery produces naphtha, middle distillates, and heavy distillates. Since no local market exists for naphtha and heavy distillates, the naphtha products

are reinjected into suspended producing wells on the mainland and the heavy distillates are flared.

A partial waterflood scheme is currently being instituted on the mainland area of the field. This project should serve as a pilot for a proposed field-wide pattern waterflood. Sufficient results from the pilot flood should be available by the year 1983 to enable the operator to have definitive criteria for assessing and formulating the most effective depletion method for the reservoir.

3.2 Reserves

3.2.1 Evidence of the Applicant. The evidence of the Applicant on the reserves and production forecasts included input from the operator of the Norman Wells oil field, Esso Resources. Esso Resources estimated that the original oil-in-place in the Norman Wells reservoir was in the order of 100 x $10^6 m^3$. The proposed expansion of the mainland waterflood to a field-wide waterflood scheme should increase the recoverable reserves from 17 percent to 42.9 percent. The field has produced 3.7 x $10^6 m^3$ of crude oil to date, and accordingly Esso Resources estimates that approximately 39.2 x $10^6 m^3$ of recoverable reserves remain.

3.2.2 Views of the Board. The Board has analyzed the reservoir data from the Norman Wells field and estimates that the initial recoverable oil reserves are 39.9 x $10^6 m^3$, or 41.2 percent of the estimate of the original oil-in-place of 96.9 x $10^6 m^3$.

3.3 Production Forecast

3.3.1 Evidence of the Applicant. The proposed field-wide pattern waterflood would consist of 133 injector wells and 119 producing wells. A fracture pattern in the reservoir and a related directional permeability trend is considered to be the dominant factor governing the waterflood, and extensive well tests and oriented cores have shown the orientation of this

system to be about N30° E. Esso Resources is proposing a five-spot production pattern with a one-to-one injector - producer ratio and a well-spacing of 6.2 hectares (15.3 acres) per well. This would result in 119 five-spot patterns, each consisting of 12.4 hectares in area, elongated in the direction of the fracture orientation for maximum sweep efficiency.

As reservoir characteristics are different in the reef margin and reef interior areas, Esso Resources simulated well performance under waterflood with a computer model in each of these areas. To arrive at a production forecast for all reef margin wells, Esso Resources applied the results of the reef margin model to all wells in the reef margin by assigning weighting factors based on the calculated porosity thickness value of each well. The same procedure was followed for the reef interior wells, and the total gross pool production forecast was arrived at by combining the two forecasts.

In discussing its production forecast, Esso Resources recognized that reservoir simulation is not a precise tool and that reservoir simulation results are sometimes optimistic as to recovery levels and production rates. For this reason, based on its experience, Esso Resources adjusted the production forecast from the simulation model downward by 30 percent. Esso Resources maintained that such a reduction in simulation rates would yield a conservative forecast of reservoir capacity and that this was confirmed by a comparison of the simulated prediction of production with the actual initial production rates of existing wells. Estimated production to the year 2022 is provided in Table 3.3.1. If the forecast production rates were not attained, Esso Resources would conduct individual well workovers or stimulations to maximize a well's productivity.

Esso Resources also provided a production forecast of natural gas liquids which indicated that expected supply would decline from about 840 m^3/d in 1984 to 610 m^3/d in 1990 and to 395 m^3/d in the year 2000. During the initial five

TABLE 3.3.1

Norman Wells Field
Estimated Field Production Rates and Pipeline Throughputs
Full Scale Waterflood Project
m3/d

Year	Reef Margin Oil		Reef Interior Oil		Total Pool Oil		Natural Gas Liquids Production Rate	Norman Wells Refinery Demand	Pipeline Throughputs Crude Oil and NGL
	Ideal Well	Total	Ideal Well	Total	Gross	Actual (70%)			
1984	99	4000	37	1640	5640	3950	840	318	4497
1986	99	4000	37	1640	5640	3950	765	318	4422
1988	99	4000	37	1640	5640	3950	690	318	4347
1990	98	3950	37	1640	5600	3900	680	318	4187
1992	95	3850	37	1640	5500	3850	610	318	4108
1994	86	3450	37	1640	5100	3550	560	318	3819
1996	81	3250	37	1640	4910	3450	510	318	3610
1998	70	2800	37	1640	4460	3100	460	318	3242
2000	59	2370	37	1640	4010	2800	395	318	2859
2002	43	1730	36	1610	3340	2350	335	318	2322
2004	32	1280	35	1540	2820	2000	270	318	1939
2006	24	960	33	1470	2430	1700	225	318	1576
2008	19	770	31	1360	2130	1500	195	318	1387
2010	16	640	29	1070	1910	1350			
2012	14	580	24	1050	1630	1150			
2014	12	500	21	910	1410	1000			
2016	11	430	17	770	1200	850			
2018	9	380	14	620	1000	700			
2020	8	330	12	530	860	600			
2022	7	290	10	430	720	500			

years, when the gas-oil ratio is high but declining, production of NGL relative to oil production would remain high.

NGL production is expected to decline in line with crude oil production after the gas-oil ratio has been stabilized by the waterflooding.

After commencement of the full-scale waterflood in 1983, Esso Resources anticipates a subsequent rapid rise in crude oil production rates of 3950 m^3/d in the year 1984. It further expects that this rate would be stable for approximately five years declining slowly thereafter. After making allowance for NGL production of 840 m^3/d and net refinery requirements of crude oil of 318 m^3/d, the initial pipeline throughput volume would be in the order of 4497 m^3/d in 1984, declining to 1387 m^3/d in the year 2008.

The required facilities to initiate the waterflood project would include 190 new wells for reservoir production and water injection. Wells would be drilled from existing land areas and from six artificial islands constructed in the Mackenzie River. Surface facilities, for gathering of production, would consist of flowlines to satellite batteries at each well cluster and gathering lines from batteries to a central processing facility on the north shore of the Mackenzie River to the west of the existing Norman Wells townsite.

Before proceeding with the waterflood project, Esso Resources was required to obtain the approval of its field development plan by the Department of Indian and Northern Affairs, under Section 6 of the Canadian Oil and Gas Production Regulations. A letter giving tentative approval of the plan by DINA, with several conditions appended, was filed by the Applicant.

3.3.2 Views of the Board. Esso Resources used simulation models in forecasting reservoir performance for the Norman Wells field. The Board agrees with Esso Resources that

reservoir simulation models are not a precise tool for forecasting reservoir performance and that results may be optimistic as to recovery levels and production rates.

Esso Resources' use of porosity thickness as a weighting factor in determining well productivity implies a linear relationship between permeability and porosity that has not been demonstrated. The Board agrees with Esso Resources that the presence of a well developed northeasterly fracture pattern in the Norman Wells field should provide a directional permeability trend that should prove to be the dominant factor governing the field's productive mechanism. The Board, however, has some concern that this facet may not have received sufficient attention in the mathematical reservoir model. The relatively close well-spacing of 6.2 hectares per well proposed by Esso Resources alleviates the Board's concern to some degree.

The Board has some doubt that the reservoir would respond to the waterflood as well as anticipated by Esso Resources. However, the Board noted that several of the conditions imposed by DINA to the tentative approval of the field development plan would result in a better understanding of the reservoir characteristics, and accordingly, a better definition and control of the potential problems associated with the waterflood program. The Board considers that the performance of the waterflood would be a significant factor in overall pool performance and would support Esso Resources' plan to monitor the performance of this flood, particularly prior to full-scale production start-up in 1984.

As the proposed pipeline would depend solely on the production from the Norman Wells reservoir, the Board prepared its own supply forecast based on an analysis using conventional methods with available core and relative permeability data. The Board estimates that the initial crude oil productive capacity of the fully developed waterflood would be 3500 m^3/d. This capacity could be maintained for approximately 13 years,

after which it is expected to be followed by an effective production decline of 6.1 percent per year to abandonment at a water-oil ratio of 21. This forecast accounts for all of the Board's estimated recoverable oil reserves ($39.9 \times 10^6 m^3$) by the year 2048. The Board's forecast, together with that of Esso Resources, is presented in Table 3.3.2.

As Table 3.3.2 shows, the two forecasts do not differ significantly; the Board's estimate is slightly lower than Esso Resources' during the early stage of the production cycle and slightly higher during the latter stage. The 30 percent reduction by Esso Resources of its simulated pool production forecast contributed significantly to the near coincidence of the two forecasts. The Board concurs with this adjustment and concludes that both forecasts are within the margin of error that could be assigned to either forecast methodology.

In summary, the Board believes that the proposed Esso Resources expansion program has a number of attractions, particularly from an energy conservation point of view. These include the availability to market of sizable volumes of NGL and heavy distillates which would otherwise be flared. In addition, gas-oil ratios would be greatly reduced under the proposed expanded waterflood scheme leading to substantial increases in recovery and rate of production of crude oil. To conclude, the Board is satisfied that the development proposal is realistic and the production forecast reasonable.

3.4 Economic Viability of Additional Crude Oil and Natural Gas Liquids Production at Norman Wells

3.4.1 Introduction. The economic viability of the Applicant's proposed system depends on the ability of Esso Resources to provide sufficient volumes of crude oil to the Applicant's system. For this reason the Board asked the Applicant to provide evidence supporting the economic viability of Esso Resources' proposed field development.

TABLE 3.3.2

PRODUCTION FORECASTS

Year	Esso Resources Forecast Oil Production m^3/d		NEB Forecast Oil Production m^3/d
	Gross (100%)	Expected (70%)	
1984	5640	3950	3500
6	5640	3950	3500
8	5640	3950	3500
1990	5600	3900	3500
2	5550	3850	3500
4	5100	3550	3500
6	4910	3450	3500
8	4460	3100	3287
2000	4010	2800	2898
2	3340	2350	2555
4	2820	2000	2253
6	2430	1700	1986
8	2130	1500	1751
2010	1910	1350	1544
2	1630	1150	1362
4	1410	1000	1201
6	1200	850	1059
8	1000	700	933
2020	860	500	726
2	720	500	726

Note: All cases assumed cumulative $4 \times 10^6 m^3$ oil produced to 1984.

The factors which have impact on that viability are sales revenues available to Esso Resources on produced volumes of crude oil and natural gas liquids, investment and operating costs, and the fiscal system under which revenues are earned and costs are incurred. At this time there is uncertainty regarding estimates of the tariff on the Applicant's proposed system which, together with prices at Edmonton and tariffs on the Rainbow system, determine revenues at Norman Wells. Uncertainties are also present in the estimates of field investment, operating costs, and volumes which can be produced at Norman Wells.

3.4.2 Evidence of the Applicant. The Applicant, with the assistance of Esso Resources, provided the results of a cash-flow analysis that examined the economic viability of the proposed field development over the 1980-2008 period. The analysis was conducted over a range of possible circumstances which could adversely affect the field economics. Present values of net revenues accruing from crude oil and natural gas liquids sales were estimated for a base case and for each of the following three cases that differ from the base case:

(1) estimated IPL (NW) tariff is increased by 20 percent;
(2) field investment is increased by 50 percent; and
(3) field production is reduced by 20 percent.

Each of these cases was evaluated using two different pricing scenarios at Edmonton. The Edmonton price forecast prepared by Foster Research was used as the base price scenario. A lower price scenario has the crude oil price averaging $\$182/m^3$ in 1984, the first year of operation, and escalating thereafter at 10 percent per year until the year 2008. Esso Resources presented details of cases, with the base case with the Foster Research and lower pricing scenarios, listing all significant cash flow streams by year.

Revisions to the results of this analysis were made by Esso Resources during the hearing. The revised results for all cases are presented in the Table 3.4.2.

TABLE 3.4.2

Present Value of Net Cash Flow

(millions of current dollars)

	Rate of Discount	Assuming Foster Research Crude Price Forecast	Assuming $182/m^3 + Escalation at 10%
Base Case	15	660	421
	20	340	198
Changes from the Base Case			
(1) IPL (NW) tariff increases by 20%	15	633	394
	20	322	181
(2) field investment increases by 50%	15	587	346
	20	268	125
(3) field production decreases by 20%	15	460	269
	20	278	104

On the basis of these results, which give positive net present value for all cases, Esso Resources concluded that its expansion of production at Norman Wells is economically viable. Although Esso Resources did not examine the possibility of all three adverse circumstances occurring together because it felt that this was improbable, it felt that the field would still be economically viable if such a case were to occur.

In conducting this analysis, Esso Resources used discount rates of 15 and 20 percent. Under cross-examination Esso Resources indicated that it would consider the expansion at Norman Wells a viable investment at a discount rate of 15 percent or more.

3.4.3 Views of the Board. The evidence submitted by the Applicant supports the conclusion that the planned field expansion at Norman Wells is economically viable given expected conditions and given a wide range of possible adverse

conditions. As part of the Board's assessment of the evidence, it conducted a discounted cash-flow analysis based on Esso Resources' estimates of investment, operating costs and production volumes, and having regard to the uncertainties inherent in estimates of future revenues and costs. Board staff have examined the economic viability of the field production under the following possible circumstances that differ by 10 to 50 percent from the base case:

(1) tariffs on the proposed pipeline system increase;
(2) field investment increases;
(3) field operating costs increase; and
(4) field production decreases.

Table 3.4.3 shows the present dollar values of the net cash flow streams calculated at varying discount rates and the current discounted cash flow rate of return for each of the cases examined. The only case in which the economic viability of the project becomes marginal occurs when production volumes are reduced by 50 percent, and a consequent 100 percent increase of the tariff is factored into the proposed pipeline system.

Based on an examination of these results, it is the Board's view that the expansion of Norman Wells producing capability is economically viable under any reasonably anticipated set of circumstances which could occur.

Because the project of IPL (NW) for the construction of the Norman Wells oil pipeline is linked to the project of Esso Resources for the expansion of its facilities at Norman Wells, should a certificate be granted, the Board would require the Applicant to file, prior to commencement of construction, documents to demonstrate to the satisfaction of the Board that all regulatory approvals had been obtained with respect to the Norman Wells oil field expansion project of Esso Resources.

TABLE 3.4.3

Economic Viability of Esso Resources' Proposed Expansion of Norman Wells Production

Case	Present Value of Net Cash Flow (millions of current dollars) Discount Rates 15	20	25	Discounted Cash Flow Rate of Return* Current
Base	379	154	42	28
Changes from the Base Case				
a) IPL (NW) tariff increases by:				
10%	367	147	37	28
15%	361	143	35	28
25%	350	135	29	27
50%	320	116	16	26
b) field investment increases by:				
10%	361	137	26	27
15%	352	128	18	26
25%	333	111	1	25
50%	278	59	(47)	22
c) field operating cost increases by:				
10%	375	152	41	28
15%	373	151	40	28
25%	369	149	39	28
50%	360	143	35	28
d) field production decreases by:**				
10%	307	112	15	26
15%	271	90	1	25
25%	193	41	(31)	22
50%	8	(72)	(106)	15

* defined as that rate of discount which reduces the present value to zero.

** a decrease in production volumes by x% results in the new tariff being equal to 1/(1-x) times the old tariff.

CHAPTER 4
MARKET AREAS TO BE SERVED

4.1 Evidence of the Applicant

The application by IPL (NW) stated that the proposed pipeline would connect the known crude oil reserves at Norman Wells with existing Canadian markets and cited the National Energy Board "Canadian Oil Supply and Requirements" report of September 1978 in support of the need to develop further domestic crude oil supply to meet Canada's long-term requirements. The Applicant's witness stated that the Norman Wells crude oil will be much needed in any supply projection which he could reasonably accept and indicated that the production of conventional crude oil will continue to decline. The witness also stated that the crude oil would probably be mixed with the Rainbow Pipe Line crude oil stream and be processed at Imperial or other refineries connected to the major trunk pipeline system.

4.2 Evidence of Intervenors

Intervenors did not question the availability of a market for the oil to be transported through the IPL (NW) pipeline, although it was argued by some that the relatively small volume of oil to be produced at Norman Wells could be saved by conservation in existing markets.

4.3 Views of the Board

The Board has considered various supply and demand projections and agrees with the Applicant's view that the supply of domestic light crude oil will continue to decline relative to Canadian demand. It is therefore reasonable to assume that a ready market would be available in Canada for the Norman Wells light crude oil to be delivered *via* the proposed IPL (NW) pipeline. As an alternative petroleum energy source, the natural gas liquids produced as a by-product of Norman Wells crude oil production would also find a ready market. The

market is expected to be available regardless of any steps taken to conserve oil since both are considered necessary.

An assessment is made in Chapter 11 of this report as to the merits of bringing Norman Wells crude oil to southern markets. At this point the Board concludes that a market would exist.

CHAPTER 5
FACILITIES

5.1 Right-of-Way

5.1.1 Evidence of the Applicant

5.1.1.1 Location. The proposed 323.9 mm diameter pipeline system originates at the production facilities of Esso Resources near Norman Wells, in the Northwest Territories, and terminates at the Zama Terminal of Rainbow Pipe Line in northern Alberta. The total length of the line is approximately 866 kilometres. Three pumping stations and other ancillary facilities are required.

5.1.1.2 Route Selection. The Applicant stated that the proposed route was selected to provide the best overall balance between environmental, technical, socio-economic, and capital cost considerations.

The Applicant indicated that in selecting the route, maximum use was made of existing cleared areas, such as highway alignments, telecommunication routes, and seismic lines to minimize environmental damage and to provide pipeline access. An interdisciplinary group was established to investigate technical considerations, which included minimizing the length of right-of-way passing through unstable soils, particularly in areas associated with permafrost soils and adjacent to water courses. Socio-economic factors that applied to the route selection included using certain portions of existing transportation corridors, and reviewing the discussions which were held at the community level to receive local input and to reflect local concerns about the route where possible.

The Applicant stated that, before selecting its final pipeline route, broad alternative pipeline corridors were laid out on 1:250,000-scale topographic maps with areas of major concern and control points identified. A corridor that did not contain any segment rejected by any member of the interdisciplinary group was then selected. The preferred

corridor was then studied in detail, and a tentative pipeline location was chosen on an engineering basis consistent with the location criteria and damage mitigation measures established for the project. The route location was then field-checked and, after refinement, was overlaid on 1:50,000 scale topographic maps, which were submitted as part of the application.

Starting in the Northwest Territories the Applicant described its proposed pipeline route in the following manner.

The originating station would be located adjacent to the Esso Resources plant facilities at Norman Wells. From there the pipeline would proceed in a generally southerly direction on the east side of the Mackenzie River, paralleling it with a separation from 1.5 to 10 km, to Fort Norman, a distance of approximately 79 km. Along this segment, the right-of-way of the proposed Mackenzie Highway would also be paralleled with a separation varying from almost 0 to 3 km. Of the first 79 km, 59 would be located on existing cleared right-of-way.

From Fort Norman to Wrigley, the proposed route would continue on the east bank of the river generally parallel to the route of the proposed highway. Approximately 156 of the 236 km in this section would be located on cleared land.

The route from kmp 315, Wrigley, to kmp 440, northwest of Fort Simpson, would parallel the Mackenzie Highway. At this point the highway crosses from the north shore to the south shore of the Mackenzie River, but the pipeline would continue southeasterly along the north shore of the river to kmp 515. Of the 200 km traversed in this section, 33 km would be on existing cleared alignment.

The line would then run along the north bank of the Mackenzie River to kmp 526 where the river would be crossed.

From there the route would continue in its southeasterly direction and at kmp 749 the Northwest Territories/Alberta border would be crossed. Forty-one of the 234 km in this section would be on existing cleared alignment.

From the border crossing to the Zama terminal, kmp 866, 28 of the 117 km are on cleared lands.

5.1.1.3 Plans, Profiles and Books of Reference. The Applicant testified that the final alignment of the pipeline would be located in the field prior to the finalizing of plans, profiles and books of reference. Work on finalizing the alignment would be based on a further review of aerial photographs.

5.1.1.4 Alternative Routes. The Applicant studied an alternative route, following the Mackenzie Highway to a point near Enterprise and then proceeding south paralleling the highway to a point east of Bistcho Lake and then southwest to the Zama terminal.

Although only one alternative route was discussed in the application, the Applicant testified that it had, in fact, considered four corridor alternatives. These were described as follows:

(1) the proposed route along the east side of the Mackenzie River;
(2) the route west of the Mackenzie River;
(3) one similar to the proposed route along the east side of the Mackenzie River, but modified south of Fort Simpson to follow the Mackenzie Highway;
(4) a route east of the Franklin Mountains.

Examination of an alternative route on the west side of the Mackenzie River was done using the results of studies conducted during the early seventies. The Applicant stated that locating the route on the west side had several disadvantages. One of the principal ones was that the tributaries located on the west side are fairly major rivers,

some having incised channels which, when crossed, would increase construction costs substantially. Also on the west side much of the soil would be of a gravelly or rocky nature which would make for more difficult ditch excavation and would require more padding operations. The west side also offered less available infrastructure than the east. The alternative corridor on the west side of the Mackenzie River was therefore eliminated for geotechnical and construction reasons, and no environmental studies were done.

The Applicant stated that the modified Mackenzie Highway route had the advantage of following an established transportation corridor and would provide better access to the pipeline. However, this alternative route would increase the length of the proposed pipeline by approximately 248 km, or 30 percent, and would require one additional pumping station. In addition to the higher capital costs of this proposal there would also be increased operation costs, maintenance staff, and land rentals. In the Applicant's opinion the advantages of easy access provided by the alternative corridor were outweighed by factors such as: more terrain requirements and additional vegetation disturbance along the longer right-of-way, greater wildlife habitat disruption, crossing additional fish habitat, and a greater potential for disturbing historic sites.

The fourth alternative corridor considered was the route east of the Franklin Mountains. IPL (NW) testified that this route was considered on the basis of geotechnical conditions, specifically that there would be a substantial decrease in the areas of permafrost encountered. However, the Applicant did not consider this alternative desirable due to the increased clearing of vegetation and disturbance to soils, as compared to the preferred route where approximately 64 percent of the right-of-way is already cleared.

5.1.1.5 Permanent and Temporary Land Rights. The Applicant indicated that the permanent pipeline easement would

generally be 20 m in width with additional temporary working space requested as required. It also stated that in areas of hilly or wet terrain, the right-of-way width could increase to a maximum of 30 m. The Applicant testified that this 10-m increase in right-of-way width would be acquired as temporary working rights.

The Applicant further stated that at major river crossings, additional right-of-way might be required to meet environmental restoration and revegetation requirements, but such additional requirements would be of short-term duration. The additional right-of-way, at major river crossings, would be required to ensure that possible future installations carried out by other companies would not be a disturbance to IPL (NW) installed pipeline.

5.1.1.6 Land Acquisition and Easement Agreements. IPL (NW) stated that it had applied for a right-of-way by way of a pipeline easement, and for rights-of-occupancy of other lands for the construction of three pumping stations to the Department of Indian Affairs and Northern Development, to the Commissioner of the Government of the Northwest Territories and to the Alberta Energy and Natural Resources Department.

IPL (NW) stated that the Alberta Energy and Natural Resources Department had acknowledged receipt of all the information required and had placed the application in abeyance pending the issuance of a certificate by the Board. The Applicant further testified that only an acknowledgement of its application had been received from the Department of Indian Affairs and Northern Development and from the Commissioner of the Government of the Northwest Territories.

To the best of its knowledge, the proposed pipeline route would not cross any private land in the Northwest Territories or in Alberta, and the Applicant foresaw no difficulties in being granted easement rights for its proposal.

IPL (NW) testified that no actual easement agreements had as yet been drawn up. The easement agreements

would contain provisions for single line rights. Any proposal to build additional pipelines would require further negotiations.

The Applicant agreed to file with the Board a copy of all easement agreements as received.

5.1.1.7 Siting of Stations. The Applicant indicated that three pumping stations would be needed, each requiring approximately one hectare of land.

IPL (NW) stated that the exact locations of Stations 2 and 3 had not been determined. Although the general location of Station 3 had been established by an on-site inspection, its final location could still change by approximately 300 m.

5.1.1.8 Land Use Conflicts. The Applicant testified that it was not aware of any mining development along the proposed pipeline right-of-way route, but that it had not checked for the existence of any mining claims along the route.

In its environmental impact assessment the Applicant's consultant, Hardy Associates (1978) Ltd., recommended that:

> Liaison between project supervisory staff and local trappers and hunters should be planned. This liaison should include: an information exchange with trappers to identify in the field potentially sensitive areas and to enable the trapper to make changes in his trapping itinerary in response to project activities; reasonable compensation should be paid to trappers for loss of imputed income; a policy enforcing contractors to ensure that project workers avoid the potential for theft or vandalism of trappers' cabins, traps, traplines, trap sets or furs, and minor adjustments of pipeline route should be made in the field to alleviate hardships that might be caused by construction of the pipeline.(1)

IPL (NW) adopted this recommendation by its consultant.

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(1) Application Vol. 3, Section 2, Environmental Impact Assessment, Hardy Associates (1978) Ltd., pp. 231-232

5.1.2 Views of the Board. The Board notes the statement by IPL (NW) that the final alignment of the pipeline would be located in the field prior to the finalizing of plans, profiles and books of reference. The Board would require the Applicant, should a certificate be granted, to conduct a field survey of the entire pipeline route on which the preparation of the plans, profiles and books of reference would be based.

The Board accepts the route selected by IPL (NW) on the basis of the evidence submitted and alternatives considered.

The Board accepts IPL (NW)'s general requirement for a 20-m wide easement, but is uncertain as to whether the additional lands required would be for permanent or temporary use. In the event a certificate were issued, the Board would require that IPL (NW) indicate on the plans, profiles and books of reference, filed pursuant to Section 29 of the Act, the requirements for all permanent and temporary rights-of-way.

Although the Applicant does not anticipate any problems in obtaining the necessary easement rights, the Board is concerned with the possibility of substantial delays in obtaining all necessary approvals for an easement for the pipeline right-of-way and the right-of-occupancy of other lands as required.

The Board accepts the undertaking of IPL (NW) to file copies of easement agreements. However, should a certificate be issued, the Board would require, pursuant to Section 29 of the Act, that IPL (NW) submit to the Board all signed easement agreements prior to the approval of plans, profiles and books of reference.

The Board recognizes the possible need for the relocation of pumping station sites during final design. In the event a certificate were issued, the Board would require that IPL (NW) indicate on the plans, profiles and books of reference, filed pursuant to Section 29 of the Act, the exact location of the three sites.

The Board notes the Applicant's statement that it is unaware of any active mining areas along its proposed route. Nevertheless, the right-of-way may be affected by mining claims. In the event a certificate were issued, the Board would require that IPL (NW) indicate on the plans, profiles and books of reference filed pursuant to Section 29 of the Act, the existence of any mining claims along the proposed route of the pipeline.

The Board accepts IPL (NW)'s measures to eliminate or reduce the potential impacts on hunting and trapping activities.

5.2 Pipeline Design

5.2.1 Facilities Design

5.2.1.1 Evidence of the Applicant. In designing the proposed pipeline system the Applicant indicated that the basic design parameters would be selected in accordance with the Board's Oil Pipeline Regulations. In particular, the line, which would carry high vapour pressure products, would be designed to comply fully with the requirements of Part X of the Board's regulations respecting the movement of high vapour pressure materials.

Specifically, the Applicant proposes to use a conventional buried mode design for the pipeline and intends to operate the pipeline at temperatures at or near ambient ground temperatures. This design philosophy was selected to minimize the thermal effects of the pipeline on the discontinuous permafrost found along the proposed route. This aspect of the design would be satisfied by controlling the input temperature at the Norman Wells end of the line through the use of chillers which would keep the oil and natural gas liquids at a level of approximately -1°C. The Applicant testified that the selection of a conventional buried pipeline design was both practical and economical and that the studies and evidence prepared for the project indicated that the line could be safely constructed and

operated. The Applicant also indicated that the data collected to date had not revealed any need for the pipeline design to include an elevated mode of construction. Further, the possibility of having to elevate the line once further analysis was done was considered highly unlikely. The Applicant, in several instances, indicated that further analysis, particularly in the areas of thaw settlement and frost heave, would be required to finalize the design.

As to the proposed pipeline's throughput capabilities, the Applicant selected a 323.9 mm diameter line with an estimated sustainable capacity of 5100 m^3 per day under winter conditions. This compares with initial throughput requirements of 4300 m^3 per day, allowing for a 15 percent surplus in daily pumping capabilities. In selecting the 323.9 mm diameter system, the Applicant also considered two alternative diameters for the proposed pipeline, one of 406.4 mm and another of 273.1 mm. The Applicant provided a comparison of the economics of the three diameters and concluded that the 323.9 mm diameter was the most economical.

The Applicant testified that the decline in the availability of crude oil throughput volumes expected over the life of the pipeline was not considered in selecting the proposed line size. It was also stated that these declining throughputs had not affected the final selection of the line size as the 323.9 mm diameter line maintained its economic advantages over the first fourteen years of the project. Another advantage of the line size chosen over a smaller diameter line was that less energy would be required to move the oil and consequently less energy would be imparted to the surrounding soil thereby minimizing the magnitude of potential thaw settlement problems.

The present proposal provides for the installation of three pumping stations. The initiating station would be located at Norman Wells with the two intermediate stations located at kmp 295 and at kmp 589 respectively. Each station

would be equipped with three pumping units providing an installed power rating of 3405 kw for the total system. Under normal conditions only two pumps would operate with the third available as standby. The Applicant provided data which graphically depicted the proposed system's ability to handle expected pumping requirements.

All pumps would be engine driven with the Norman Wells station using natural gas as fuel while the two intermediate stations would burn diesel fuel. The natural gas would be supplied by others at Norman Wells while the Applicant proposed to store diesel fuel on-site at each of the downstream stations. The Applicant indicated that the use of diesel fuel and natural gas as fuels for the pumping stations was the most economical from a practical and reliability point of view. Economic evaluations of the proposed design were provided by the Applicant.

The Applicant stated that all pumping facilities would be designed in accordance with the relevant codes and standards governing pumping stations. All major mechanical and electrical equipment would be housed in heated insulated buildings. Electric power would be purchased for the Norman Wells station while power would be generated on-site at the two downstream stations. All stations would be provided with alarm and control equipment designed to allow for a fail-safe mode of operation should an emergency condition arise.

5.2.1.2 Views of the Board. The Board recognizes that the Applicant has selected its general design parameters in accordance with the requirements of the governing regulations, codes, and standards and is satisfied with that aspect of the proposed design.

The Board agrees with the selection of a conventional buried mode design for the pipeline. However, it is evident from the information available to the Board that additional geotechnical and other studies would be required before the completion of final design. Such studies

would need to further address the ramifications of burying a pipeline in discontinuous permafrost. The Board would require that the final design reflect the results of these additional studies as more specifically discussed in the Geotechnical and Geothermal Design sections of this chapter.

The Board finds that the selection of a 323.9 mm diameter pipeline for the movement of the anticipated crude oil and NGL volumes has both economic and operational advantages over the two other pipe diameters considered for the project. Although the available throughput volumes would decline over the life of the project, the Board concludes that the economic benefits in the earlier years derived from the selection of the 323.9 mm diameter outweigh the marginal advantages of a smaller line in the future years. Moreover, the smaller line does not show advantages until 1998, 15 years after the proposed start-up of the line.

In analyzing the proposed pumping station configurations the Board has found the design to be satisfactory. The Board is satisfied that the system, as described, is capable of handling the expected pumping requirements and has enough flexibility to cope suitably with the range of flows that may be encountered during the operation of the pipeline.

It is obvious to the Board that the use of diesel fuel and natural gas as fuels for the pumping units is the most practical method of providing power. The lack of a reliable source of electric power along the proposed route combined with present day experience in the use of fuel powered engines support the proposed design. The Board, therefore, concludes that the use of engine-driven pump units is both economically attractive and technically feasible.

The Board notes that the details of the selection of station piping, alarm and control devices, and other ancillary facilities at the pumping stations are yet to be finalized and the Board would require that these final designs be submitted for approval prior to construction.

5.2.2 Stress Analysis and Materials

5.2.2.1 Evidence of the Applicant

5.2.2.1.1 Line Pipe. The Applicant indicated that 323.9 mm diameter Grade 359 MPa pipe would be used for the proposed pipeline. The wall thicknesses selected for the mainline are as follows:

Location			Wall Thickness
kmp 0	to	kmp 345	6.27 mm
kmp 345	to	kmp 584	5.33 mm
kmp 584	to	kmp 661	6.27 mm
kmp 661	to	kmp 866	5.33 mm

The selection of the pipe wall thicknesses resulted from a stress analysis performed by the Applicant. This analysis considered engineering stresses and strains that the pipe would experience as a result of anticipated loading conditions such as internal pressure, temperature differentials, differential settlement and overburden. The Applicant set allowable stress and strain limits based on design criteria outlined in the Board's Regulations and the CSA Z183 Standard and compared the results of the analysis with these limitations. The Applicant concluded that the proposed design satisfied code requirements.

Of particular concern, and the subject of much discussion respecting the stress analysis, was the effect of differential settlement. The Applicant was confident that it generally had selected "worst case" conditions in predicting the amount of differential settlement that could occur and that the analysis showed that the pipe, as selected, could withstand these settlements without structural damage. The Applicant, however, recognized a need to monitor the pipeline once installed to ensure that the predictions were accurate and to take corrective action should it become necessary.

The Applicant specified that the pipe to be used would conform to the requirements of the CSA Standards Z245-1 and Z245.5 covering ERW line pipe. Moreover, the Applicant provided line pipe specifications and indicated that all material specifications, manufacturing and testing would meet or exceed the requirements of all relevant codes, standards and applicable Board regulations. The pipe would be required to satisfy the notch toughness requirements for Category II piping as specified in CSA Standard Z245.5-M-1979.

5.2.2.1.2 Other Materials. The Applicant provided typical specification sheets for pumping station piping, valves, and fittings. The selection of these materials was in accordance with all the relevant codes and standards applicable to the service conditions identified by the Applicant for its project.

5.2.2.1.3 Quality Assurance. The Applicant indicated that during manufacture all of the pipe and major components (such as valves and fittings) would be subjected to independent in-plant inspection performed by the Applicant or its representative to ensure compliance with the applicable codes or regulations.

5.2.2.1.4 Availability. The Applicant testified that the production of line pipe would require about six months lead time under normal circumstances but, should the need arise, a shorter delivery schedule was possible. Other materials such as valves, fittings, flanges, etc., were felt to be regular shelf items.

5.2.2.2 Views of the Board. The stress analysis conducted by IPL (NW) considered most situations of single and combined stresses. The design criteria and stress and strain limits established for the analysis are judged by the Board to be viewed as reasonable.

The Board is concerned by the lack of site-specific data on loading conditions resulting from thaw settlement and frost heave although this concern would in part be offset by the monitoring program proposed by the Applicant. The Board, however, would require that site-specific data be obtained and that analyses be performed to ensure the adequacy of the final design. Further, any monitoring program would be required to have well-defined parameters as to measuring procedures, critical values of pipe movements, and mitigative and corrective procedures. A more detailed discussion of this is found in the Geotechnical section of this chapter.

The selection of line pipe and other material properties and specifications have been well documented by the Applicant. The Board is satisfied that the materials would meet applicable code and regulation requirements and pose no delivery problems.

5.2.3 Geotechnical and Geothermal Design

5.2.3.1 Geotechnical Assessment

5.2.3.1.1 Evidence of the Applicant. In its geotechnical assessment of the proposed pipeline route, the Applicant reviewed existing literature pertaining to the general area between Norman Wells and the Zama Terminal. The data itemized in the application included the following:

(1) previous studies by Canadian Arctic Gas Study Limited, Foothills Pipe Lines Ltd., Beaufort-Delta Oil Project Limited, and Mackenzie Valley Research Project

(2) previous studies by the federal Departments of Public Works, Indian and Northern Affairs, and Energy, Mines and Resources

(3) review of existing government aerial photographs, air photomosaic maps and topographic maps

(4) a review of 1:50,000-scale terrain-typed photomosaic maps compiled from the Beaufort-Delta Oil Project.

The Applicant indicated that the above data were used to establish the terrain conditions along a general routing for the proposed line. Air photos reviewed by the Applicant were used to identify the location of cleared rights-of-way that would be suitable for use along various alternative routes.

The proposed pipeline route lies within the discontinuous permafrost zone. Based on the studies carried out by Canadian Arctic Gas Study Limited, the Applicant divided the proposed route into the following three climatic regions:

Region 14 - Norman Wells (kmp 0) to south of Police Island, (kmp 110) - 93 percent permafrost.

Region 15 - south of Police Island (kmp 110) to Willowlake River (kmp 376) - 77 percent permafrost

Region 16 - Willowlake River (kmp 376) to Zama Terminal (kmp 866) - 34 percent permafrost.

The Applicant's analysis of the geotechnical data indicated widespread distribution of permafrost in Region 14, a sporadic distribution of permafrost in Region 16 and a transition zone, Region 15. It was noted in the application that a marked change in permafrost occurrence was identified near the Ochre River.

For the purpose of compiling a geotechnical assessment of the proposed route, the Applicant followed a study procedure which included the evaluation of sensitive terrain areas. The Applicant described terrain sensitivity as a measure of the degree of reaction of terrain to man-made disturbances. The review of terrain-typed air photomosaic maps, in conjunction with the studies previously mentioned, enabled the Applicant to establish a geotechnical mapping of the proposed route and to identify the various terrain units to be traversed. These terrain units were categorized as to their sensitivity which allowed the Applicant to develop a preliminary geotechnical assessment. The Applicant concluded that performing its

construction work in winter after the terrain surface was properly frozen would generally have a minimal effect on terrain units along the proposed route.

The Applicant testified that for approximately 32 percent of the proposed route the subsurface information reviewed related to boreholes placed up to ten km away from the proposed line location. Further, boreholes, in certain instances, were at a higher elevation than the proposed route. The Applicant contended that significant terrain changes would not be apparent in a five km shift of location. The Applicant further stated that the discrepancy in elevation was of little consequence and "better" terrain would likely be located at the lower elevation of the pipeline route. The Applicant indicated a smaller percentage of permafrost would likely be encountered at lower elevations and no significant changes in permafrost characteristics would be noted.

The Applicant described proposals for a further site-specific borehole analysis of terrain along the pipeline route, as these would be required to obtain sufficient final design information. The Applicant stated that the areas along the route where adequate subsurface information was lacking were "basically all along the route."

5.2.3.1.2 Views of the Board. The Board recognizes the preliminary nature of the geotechnical assessment presented by the Applicant and is satisfied with this phase of the analysis.

The Board is of the view that a complete and comprehensive terrain investigation is fundamental to the Applicant's accurate geotechnical assessment of the proposed route. The Board agrees with the Applicant that further geotechnical assessment through the analysis of site-specific subsurface investigations should be an initial step in the formulation of final designs. Of particular concern is the corroboration of the Applicant's

geotechnical mapping of terrain units with geophysical data gathered at sites coincident with the final pipeline location. The Board would require the identification and assessment of areas sensitive to terrain degradation and the field investigations for the evaluation of:

(1) slopes which may become instable;
(2) river crossings and approaches thereto; and
(3) interfaces of frozen/unfrozen soil where special designs may be required.

5.2.3.2 Geothermal Analysis

5.2.3.2.1 Evidence of the Applicant. The Applicant presented, as part of its geotechnical assessment of the pipeline route, a geothermal analysis of terrain on the proposed route. In its analysis, a review of ambient and ground temperatures was undertaken and used as input for establishing a pipeline temperature profile. The amount of permafrost and unfrozen ground, along with the effective summer and winter temperatures, were estimated for the purpose of this study. The analysis of pipeline temperature was conducted to determine the length of unfrozen ground which would warm the pipe contents to the point where thawing of adjacent frozen soil would occur. A second objective of the analysis was to establish the length of frozen ground which would produce the opposite result. Consequent to the above, the potential for frost heaving and thaw settlement was reviewed and evaluated. The Applicant stated that the results of the above studies were used as an input in the evaluation of various routing options.

Based on the work undertaken by Canadian Arctic Gas Study Limited and the Applicant's own computer simulation of ground temperature profiles, various conditions along the route were examined to assess the

potential for permafrost degradation. From these studies the Applicant concluded the following:

(1) the temperature of the pipeline would be controlled by adjacent ground temperatures; and

(2) pipeline temperature would increase quickly when passing through warm adjacent ground and decrease slowly as the pipeline passed into cooler permafrost areas.

The Applicant stated that, as a result of the above, the temperature of the pipeline would be maintained close to ground temperatures and thermal input would be minimal. An exception to this conclusion was cited for the case of the pipe passing through several kilometres of continuously frozen into unfrozen ground and then back into frozen ground. These cases were presented as those in which frost heave in the former case, and thaw settlement in the latter, might be encountered. Further discussions regarding these contingencies are contained in the respective sections of this report.

A survey of ground temperatures, measured at 0.5 m depth, along with thermal conductivity values were presented in the Applicant's proposal. The thermal conductivity value, "k", was represented as a constant 1.696 W/m °C over the entire length of the pipeline route. The Applicant agreed that the numerical value for thermal conductivity varied directly with soil properties and terrain conditions. The Applicant suggested a more accurate representation of thermal conductivities might have been gained by tailoring the value of "k" closely to changing soil types. It was further stated that thermal conductivity values, in spite of the care taken to determine them, were only accurate to $\pm$10 to 15 percent. The calculation of heat flow "q" was found to be insensitive to changing "k" values. The Applicant maintained that the value of 1.696 W/m °C used for thermal

conductivity in its heat flow analysis was valid for preliminary purposes.

The Applicant, in its analysis of the effects of thermal input of the proposed pipeline to its surroundings, described a "worst case" approach. In its view, the predominant factor causing permafrost degradation was increased heat flow from the ground surface. It was stated that increased heat flow from the surface, due mainly to clearing of right-of-way and construction disturbance of surface strata, would be the major initiator of thaw settlement. The analysis submitted by the Applicant indicated that the effect of warm oil flowing through the pipeline would be substantially less than those of heat input from the above.

To establish its worst case analysis, the Applicant considered the case of permafrost degradation occurring as a result of clearing the right-of-way surface. The above condition was then compounded in the analysis by the addition of a "warmed" pipeline temperature acting on the permafrost layer. The reverse situation was applied for the case of the pipeline freezing an existing unfrozen strata. The Applicant indicated that the results of the analysis predicted a small drift in ground temperature, rising slightly when passing from frozen to unfrozen strata and falling slightly in the case of unfrozen to frozen. Regarding the length of line in either frozen or unfrozen strata, the Applicant indicated that a distance of 100 km of frozen soil interfacing with the same length of unfrozen soil was used in the above analysis.

The Applicant predicted that actual line performance would fall between the maximum and minimum temperature ranges. The Applicant further contended that actual field conditions would not reproduce the severity of the conditions used in the simulation.

5.2.3.2.2 Views of the Board. In light of the preliminary nature of the Applicant's geotechnical analysis and given

the exceptions noted in the Applicant's evidence, the Board had concerns regarding the long-term effects of the pipeline on frozen/unfrozen interfaces in the discontinuous permafrost zones. The Board's reservations stem from the Applicant's statement that the reaches of frozen and unfrozen areas as well as the incidence of these reaches had not yet been ascertained. While the Board concurs with the Applicant's contentions regarding the thermal performance analysis for the proposed line, it has concern respecting the extent to which field extremes may be inconsistent with the Applicant's analysis. It is the Board's view that to assess and mitigate the problems anticipated in traversing discontinuous permafrost zones, an evaluation of the extent and incidence of frozen/unfrozen reaches should be attempted, possibly leading to a more accurate forecast of field conditions. The Board would require that the final design incorporate any additional information compiled from this endeavour.

5.2.3.3 Thaw Settlement

5.2.3.3.1 Evidence of the Applicant. Following the analysis of the effects of the pipeline passing through the discontinuous permafrost zone, the potential for frost heave and thaw settlement was evaluated by the Applicant. The Applicant contended that in the instance of the pipe traversing a stretch of unfrozen ground, and then entering a frozen section, the potential for the pipe to thaw the surrounding permafrost required further investigation. Based on the results of preliminary studies, the Applicant identified sensitive terrain areas with respect to thaw settlement, thawing of permafrost slopes and frost heaving. These areas were indicated on the Applicant's geotechnical maps.

It was noted in the application that high terrain sensitivities existed in glaciolacustrine deposits with high ice contents. If disturbed this material could experience thermokarst subsidence in flat areas. The

Applicant further submitted that frozen and unfrozen organic deposits were rated at high sensitivities in their study. It was believed that although organic surface deposits could recover from disturbances by regrowth, underlying strata might experience an increase in sensitivity and thermokarst subsidence could result.

The Applicant stated, on the basis of the borehole information it reviewed, that a great majority of the holes drilled near the selected prime route exhibited low to medium ice contents. The Applicant identified areas of potentially sensitive terrain along the route as those areas which might contain medium to high ice content. It also stated that special mitigative measures with respect to thaw settlements in these areas would be required.

From the results of its geothermal analysis, the Applicant concluded that the pipeline temperature was controlled by the temperature of its environment. Further, it was stated the pipeline would warm quickly but would cool slowly. On the basis of the above a minimal thermal impact would be exerted by the pipeline. An exception would be the case of the pipeline passing through long unfrozen sections and then into frozen reaches. The potential for thaw settlements in this case was identified in the application.

The Applicant stated that not all disturbed right-of-way examined along the prime route area showed signs of permafrost degradation. Given the results of its geothermal analysis, the Applicant contended that since the thermal input from the pipeline was deemed minimal, permafrost degradation along the proposed route would be similar to that of a cleared area. Where the pipe was warmed up by long unfrozen terrain stretches, the Applicant indicated that some additional thawing under the pipe would occur in addition to that attributable to surface disturbance when it passed through continuous permafrost zones.

The Applicant submitted that, for most of the terrain units along the proposed route, the anticipated

magnitude of thaw settlement was less than 0.8 m. This figure was based on the contention that most soils along the route contained low to medium ice contents. The Applicant indicated that a main exception to the above would be in areas of thick organic peat plateau, particularly a 65 km stretch south of the Ochre River. For this area the Applicant submitted that a thaw settlement magnitude of 1.0 to 1.2 m could be expected. The Applicant stated that further field and laboratory work would need to be undertaken in order to locate exact areas where settlements of up to 1.2 m could be expected. In its view no mitigative measures for settlements of this magnitude were necessary. It stated that from a pipe integrity point of view a 1.2 m settlement was not critical. The design of the pipeline and the selection of pipe sizes and wall thicknesses were checked using the 1.2 m differential settlement as a design parameter. For differential settlements of a magnitude greater than 1.2 m to occur two to three years would be required, allowing sufficient time for detection and corrective action. A differential settlement magnitude which might be deemed critical to the integrity of the line was defined as that settlement which would deform the pipe to its critical radius of curvature at the points of contraflexure.

The Applicant stated that, given the period of time required for settlements to develop due to thawing of a magnitude critical to the pipe, a program of monitoring and observation would be established. It contended that settlement areas of a critical nature would manifest themselves as areas of depression up to 30 m or more in length. Areas such as these, if they developed along the route, would be detected by the Applicant's proposed overflights or ground walks along the line. The Applicant stated that 15 cm settlement could be detected in an overflight survey.

The Applicant stated that no attempt to rectify a detected settlement would be made until the radius of curvature of the pipe in the suspect area had been measured. Should the measured value of the radius of curvature be less than the critical radius of curvature, no repairs would be initiated. The environmental complications caused by a repair attempt during the thawing seasons were given as the reason for reluctance to restore areas of differential settlement.

The Applicant stated that much more detailed "as built" plans would be compiled for the proposed line. The drawings would accurately locate the original position of the pipe in the soil so that comparisons of movements could be made against an accurate bench mark. To measure the radius of curvature of the pipe in a suspect area electromagnetic surveys or probing were planned by IPL (NW). The proposed frequency of field surveys was an overflight once per week, valve inspections monthly and a field walk or settlement observation survey on an annual basis.

The Applicant acknowledged that consequent to thaw settlements or differential settlements occurring along the route, depressions in the terrain surface would result. A water ponding effect in these depressions would tend to disrupt the drainage patterns in certain areas and also contribute to further degradation of permafrost in underlying strata.

Regarding its ability to measure radii of pipe curvature in water-filled areas and to detect critical settlement locations, the Applicant stated that large water ponds would serve to highlight critical areas. Measurement of deflected pipe curvature would proceed after draining of the ponds. The potential for increased permafrost degradation was not considered to be a major concern by the Applicant. Attempts to restore the right-of-way by repairing or regrading a depression would not be made.

The Applicant indicated that no areas adjacent to the pipeline would be included in the monitoring program. A special case might be considered if a slope adjacent to the pipeline was in danger of failure. However no lateral observations would be routinely included.

The Applicant contended that, given the predictions of 0.8 m settlement for most terrain units and 1.2 m settlement for the organic peat areas, its proposed monitoring of right-of-way performance would be adequate to ensure the integrity of the pipeline.

5.2.3.3.2 Views of the Board. The Board is generally satisfied with the Applicant's analysis of thaw settlement. However, the Board has some concern with those areas, as yet unidentified, where thaw settlement magnitudes might exceed those predicted. A subsurface investigation would be necessary to provide a data base for the quantifying of high, medium and low ice contents and a subsequent verification or revision of settlement magnitude prediction. Further, the areas along the pipeline route where settlement problems might be expected would need to be located and any special consideration to be applied reflected in the final design. The results of the above investigations would also allow for the location of areas in which settlements of a critical magnitude might occur within a shorter time frame than two to three years.

The Board accepts the Applicant's contention that the major source of heat effective in degrading permafrost would, for the most part, be supplied from the disturbed right-of-way surface. The Applicant's contention, that by using previously degraded rights-of-way a small amount of additional thawing under the pipe would occur, appears consistent with the analysis reviewed by the Board. The Board concurs with the Applicant's proposal to use existing rights-of-way whenever possible.

Of concern to the Board is the Applicant's intention to not attend to settlement sites unless the magnitude of settlement is approaching a critical depth. The Applicant has indicated that due to terrain disturbances which would be caused by a restoration attempt, the above approach was adopted. The Board's concern is for the environmental ramifications of not attending to settlement sites. This concern is further addressed in Chapter 7 of this report.

The Board accepts the Applicant's proposal to monitor the performance of the line during operation. The Applicant's program, if diligently followed, would allow for identification of problem areas and provide adequate lead time for restoration to be initiated. However, the Board notes that even with a monitoring program in place the need for further site investigations and analysis of subsequent data would not be alleviated. It is the Board's view that with monitoring through overflights and walking the right-of-way sufficient data or settlement conditions could be compiled and the pipe integrity could be maintained.

5.2.3.4 Frost Heave

5.2.3.4.1 Evidence of the Applicant. The Applicant presented the results of its geothermal analysis relating to the potential for freezing of unfrozen soils around the pipe. Based on the results of its analysis, the Applicant concluded that a frost bulb which would develop around the pipe would extend to a depth of about 1 m below the pipe should the line pass through a stretch of permafrost and then into an unfrozen soil section. Further, it contended that the frost bulb would thaw completely over a spring and summer season. The Applicant also stated that although the results of the geothermal analysis indicated that the pipe temperature would be dominated by its environment, for the

purpose of the above analysis cold pipeline temperatures were used. On the basis of the foregoing, the Applicant concluded that frost heaving would not be a design or operating problem.

An exception to its conclusion was with respect to frost heave design considerations at a few river crossings where, upstream from the crossing, a long section of frozen soil was encountered. Such situations were a definite possibility for the most northerly portions of the route; the Applicant would provide for them by using an insulating barrier around the pipeline, virtually eliminating freezing under the conditions postulated. It further indicated that to date none of these areas had been identified.

The Applicant stated that most soils along the pipeline route could be considered frost-susceptible with the exception of gravel deposits located at some river crossings. An analysis was provided which, on the basis of a number of different assumptions, indicated that the magnitude of frost heaving could range from 8 to 30 cm. Further, it stated that terrain freezing would only occur in areas where the pipeline passed from a lengthy permafrost section into a stretch of unfrozen soil. Frost heaving resulting from freezing of the soils by the pipe would only occur in frost-susceptible soils with access to groundwater. It was the Applicant's contention that a displacement of the pipeline resulting from a frost heave of the magnitudes predicted would not affect the integrity of the line. Moreover, seasonal freezing cycles would not produce a compounded displacement of the pipeline given the complete annual thawing of frost bulbs which might form around the line.

5.2.3.4.2 Views of the Board. The Board is satisfied with the Applicant's frost heave analysis. It notes, however, that areas of lengthy permafrost sections either adjacent

to rivers or bounded by unfrozen soils are, as yet, unidentified. It is the view of the Board that, given the detection of these areas, mitigative measures as proposed by the Applicant should adequately protect the integrity of the line.

5.2.3.5 Slope Stability

5.2.3.5.1 Evidence of the Applicant. The thawing of permafrost slopes was cited as one of the most troublesome geotechnical concerns associated with the construction of the proposed pipeline. The Applicant stated that slope stability was a part of the design that was very sensitive to changes in information or conditions found in the field. In other words, conditions encountered during construction would have considerable bearing on the slope stability design.

The Applicant presented a summary of measures which it had established for stabilizing slopes where there were problems due to the thawing of permafrost. These were presented with respect to slope angle. They mainly involved excavating soils around the pipe and replacing them with granular materials to ensure adequate drainage of the slope. The Applicant stated that the rate of thawing on permafrost slopes directly affected the quantity of water liberated. Free moisture in the soil reduces the shear strength of the soil mass on the slope thereby increasing its potential instability. By providing increased drainage capabilities on slopes, shear strength reductions could be minimized. For those slopes of angles greater than 20°, site-specific designs were suggested. From an analysis of terrain units along the route the Applicant indicated that no prevalent modes of mass-wasting phenomenon were noted. From observations made of an area 100 m wide, the Applicant submitted that no large slides had been observed on the route.

In its application, IPL (NW) indicated that the most unstable slopes were those in ice-rich, fine-grained soils. Prevalent modes of slope failure in permafrost areas were stated as active layer detachment slides, retrogressive thaw-flow slides, and slumping of slopes. The Applicant stated that, due to construction disturbances and clearing of vegetations on slopes, the active layer would be thickened. It was reasoned that, given the increased permafrost degradation due to surface disturbances, the potential for an active layer detachment slide would be increased. The Applicant indicated that, should such a slide be initiated, its magnitude or depth would be greater than that occuring in nature. Due to an eventual termination of thaw front advancement, the increased slide potential would not magnify with time. As is generally the case, a slope failure in permafrost areas would be accompanied by a retrogressive phenomenon and with time the area of influence would tend to become quite large. The Applicant submitted that this would be the result should a slope failure on the right-of-way be left unchecked or no attempt made at restoration. At sites of detected slides an attempt at slope stabilization would be made. The primary mitigative efforts would take the form of excavation of permafrost soils on the failure site and replacement with gravel providing better drainage, removal of debris, and installation of insulation barriers to decrease the rate of thawing.

The Applicant addressed the concern of a winter construction program on slopes resulting in a large scale failure. It was stated that although this was not expected to occur, on some slopes an increase in the potential for slope failure might result from the operation of the pipeline during thawing seasons. Should such problems materialize they should be identified by the line performance and right-of-way monitoring programs.

Slope stability design was indicated as very sensitive to information gained from the field. In outlining a proposal for site investigations along the route, a program of identifying sensitive slopes from actual borehole drillings was presented. Of particular concern to the Applicant was that portion of the route between Norman Wells and the Willowlake River area where virtually all of the sensitive slope areas are located. The Applicant stated that, without the proposed site investigations, particularly sensitive slopes could not be identified. The actual position of the pipeline on a given slope was plus or minus 300 m. At present, areas of increased slide potential could not be identified. The results of the proposed future borehole investigations would be required for design purposes.

5.2.3.5.2 Views of the Board. The Board concurs with the Applicant's view that further investigations are required to ensure an adequate slope stability design. As indicated by the Applicant a number of concerns exist in this area, and it is the Board's view that comprehensive slope designs are fundamental to the integrity of the line. Sufficient site-specific information acquired with respect to terrain types would allow for the formulation of slope designs tailored to field conditions. Further, the subsurface assessment of slopes would allow for the predictions of slide potentials, the assessment of potential retogressions in the event of a slide, and the establishment of factors of safety for various slide modes on steep slopes.

The Board agrees with the Applicant's proposal to monitor the performance of slopes. Initiating restoration attempts at sites of slope failures as quickly as possible would serve to mitigate the retrogressive effects of a slide.

The Board is satisfied with the Applicant's suggested contingency plans for restoration of slope failures. The Applicant's proposals to increase subsurface drainage on slopes and to inhibit thawing on slopes where necessary appear consistent with attempts to mitigate those factors which contribute to slope instability. The Board agrees that with additional subsurface information on slopes along the route, the Applicant would be in a position to assign specific mitigative measures to individual slopes along the route. By doing so, any restoration attempts on slopes so identified would immediately attack those conditions which directly contributed to the instability problem.

5.2.3.6 Drainage and Erosion Control on Slopes

5.2.3.6.1 Evidence of the Applicant. Drainage and erosion control measures for most areas along the right-of-way would follow standard pipeline practices. A surface layer of peat which covers the right-of-way for virtually its entire length was cited as being highly erosion resistant. The Applicant contended that sufficient volumes of water flowing at high enough velocities to erode the interwoven organic mat were not likely to occur. The case of sloping terrain in areas of till plains was brought to the Applicant's attention. An example of existing erosion problems was presented from the text of a report entitled "Terrain Evaluation - Mackenzie Transportation Corridor, Central Part."(6) The authors of that report contended that the main hazard in sloping till plains was erosion caused by disturbance of natural drainage patterns. Alterations of the terrain which tend to concentrate the face water into a channel would have marked effects on the erosion of the slope. Erosion along the right-of-way, if left unchecked, would progress with every season. The Applicant agreed with the findings of the report but

outlined proposals to mitigate the erosion problem. The Applicant added that the authors of the report were using examples of eroded areas left unrepaired. This would not be the case in the proposed project.

A diligent program of monitoring by operations and maintenance staff was proposed as an important part of mitigative measures. With the site-specific erosion and drainage control measures proposed and diligent monitoring, the Applicant contended that erosion on the right-of-way would be minimized. The erosion monitoring program would be instituted for the first three years after construction. This was deemed the most critical period.

An area requiring special consideration regarding drainage control was that relating to depressions left along the right-of-way subsequent to the thawing of permafrost. In sloping terrain a system of small dykes was proposed to prevent flowing surface water from attaining erosive velocities. On gentle slopes, 3° or less, dykes placed at 300-500 m spacings were proposed. On slopes greater than 3° a granular capping on the dykes was proposed. The drainage and erosion control measures for a group of about "20 special slopes" would require site-specific investigation and design.

5.2.3.6.2 Views of the Board. The Board is satisfied with the Applicant's approach to the control and mitigation of drainage and erosion concerns. It is the view of the Board that the integrity of the proposed line could be adequately assured through the diligent application of the proposed methods. The environmental ramifications of the Applicant's drainage and erosion control measures and the Board's views regarding this facet are presented in Chapter 7 of this report.

5.2.3.7 River Crossing Design

5.2.3.7.1 Evidence of the Applicant. In its application IPL (NW) categorized river crossings along the proposed

route as "major crossings" where widths were in excess of 275 m, as "intermediate crossings" where widths were from 45 m to 275 m, and as "minor crossings" where widths were less than 45 m. A total of 2 major, 4 intermediate, and approximately 65 minor crossings were identified. Typical preliminary designs for the major river crossings on the Mackenzie and Great Bear Rivers along with intermediate crossings on the Ochre and Willowlake Rivers were submitted.

In its application, the Applicant stated that little difference exists in the climatic conditions between Fort Simpson and Norman Wells. The mean annual precipitation for the area was given as 330 mm, most of which falls as rain. The runoff ratio for the terrain of the drainage basins was submitted as being from 0.2 to 0.5. Major peak flows in the upper Mackenzie region were stated as prevalent during late May or early June, usually resulting from snowmelt. Peak flows on individual rivers were given as occurring during ice jam break-up conditions. The Applicant acknowledged that summer hydrographic peaks could sometimes exceed spring flood peaks given conditions of intense local rainstorms.

Typical design data including hydrologic conditions, channel bank descriptions, drainage basin areas and design flood discharges were presented by the Applicant for the two major and two selected intermediate river crossings. The approximate locations of the proposed pipeline crossings of the rivers were also indicated.

The Applicant indentified three potential hazards which might lead to exposure of the pipeline due to abrasive stream flows:

(1) exposure on a river bed due to general bed degradation or local scour at the crossing location;
(2) bank erosion which had progressed beyond the sag points of the river crossing; and
(3) exposure resulting from erosion of a flood plain through which the pipeline passes.

The Applicant submitted that the above hazards would be considered in establishing the depth of cover, location of sag points and elevation of the line in a channel bottom at the river crossings. At the Great Bear River crossing the soil material of both banks was assumed. The bank material for the Mackenzie River was established by boreholes on the south bank of the river only. The bank material on the Ochre River was established by boreholes on both sides of the river, while at the Willowlake River only one bank had been investigated. The design floods for the Mackenzie River and Willowlake River were submitted as 100-year and 40-year floods respectively. Design flood data for the Ochre River were not included. The 50-year flood was used for the Great Bear River.

Although typical construction procedures for minor river crossings were filed in the application, it was stated that the actual crossing design of a given water course would be finalized on the basis of site-specific information not yet available.

The Applicant stated that a geophysical investigation of river crossing approaches was required to finalize a given crossing location, design and configuration but that to date no contracts for this work had been let. At present the final location of the pipeline on a given river reach could not be established to a tolerance of less than $\pm$300 m, the proposed line corridor width. Dependent on the results of the proposed site-specific investigations, river crossings locations would be finalized for design and location. The slopes of river banks were stated as being of particular concern, particularly in relation to the sensitivity of these slopes to disturbance from such operations as preclearing. The proposed geophysical investigation of river crossings would specifically address this concern. Further subsurface investigations were proposed by the Applicant for the purpose of determining, from a geotechnical viewpoint, the

feasibility of using a specific location as a watercrossing approach. Special design features or possibly relocations of proposed crossing sites would be considered as more subsurface information becomes available.

The Applicant stated that for a few of the river crossings the potential for scouring of the river bed had been investigated. This problem would be further investigated when site-specific surveys of the river crossings were made.

The Applicant expressed a "fairly high level" of confidence in its ability to design the required river crossings. In support of this it was stated that, with reference to the information reviewed by the Applicant, a substantial amount of data was available for design purposes. The flood plains of the northern rivers were not frozen. The design of these river crossings would not involve the use of any new concepts. The design of the river crossings along the proposed route was reasoned not to be substantially different from those presently in place on the Applicant's existing pipeline system. In addition, it was stated that a large amount of borehole data from nearby locations was reviewed. From this review, the Applicant claimed that there existed a good indication of terrain to be encountered. The Applicant maintained that its designs of northern river crossings were based on well-established river engineering design methods.

5.2.3.7.2 Views of the Board. The need for further detailed, site-specific investigations of river crossings along the proposed route is obvious. A comprehensive evaluation of subsurface conditions on slopes and river approaches prior to establishing final design criteria would be required.

The Board views the sensitivity of slopes at crossing approaches and the identification of long frozen sections upstream of crossings as critical to the final

location and design of river crossings. The Board would require that the above information form an integral part of the data on which final designs would be based.

The Applicant stated that further information concerning hydrology data, depths of seasonal scour and river dynamics would be required prior to establishing a given river crossing design. The Board concurs with the Applicant. It was the Applicant's contention that well-established river engineering concepts would be employed and that no new concepts would be required. The Board, while accepting the Applicant's statements, believes that field conditions encountered might not necessarily be those anticipated. The Board therefore would expect that field conditions would have to be reflected in final design.

5.2.4 Construction

5.2.4.1 Evidence of the Applicant. The Applicant proposes to construct the pipeline facilities over three winter construction seasons with some work being performed during the summers between January 1981 and November of 1983. During the first winter season (January-April 1981) the Applicant originally proposed to preclear those sections of the right-of-way where construction was scheduled to take place during the winter of 1981-82, and to carry out line surveying operations. However this schedule was based on the Applicant receiving regulatory approvals by November 1980. As it became obvious that regulatory approvals could not be forthcoming by November 1980, the Applicant indicated at the hearing that the time alloted for the preclearing operations might be reduced. The opportunity to integrate northern businesses into the construction program would likely also be reduced correspondingly. Preclearing not done in the winter of 1981 would be done immediately prior to construction in the winter of 1981-82. This would then change the Applicant's construction philosophy, in that a large part of

the reasoning for preclearing was based on the contention that advanced clearing would promote earlier permafrost degradation and considerable drying of the right-of-way prior to construction. This in turn would lead to smaller initial settlements following pipeline installation. Therefore, if clearing one year in advance of construction were not possible, larger thaw settlements in the first year of operation could be expected. The Applicant did not believe this to be a problem.

The Applicant also indicated that because approximately 70 percent of its right-of-way in the section between Norman Wells and the Willowlake River would follow existing cut lines, and this was not the most settlement-prone area, the problem of first-year thaw settlement would be minimal.

The Applicant indicated that water, road, rail and air transportation systems, construction manpower and equipment, and other logistical support exist in sufficient quantities to permit the construction of the pipeline on schedule, as most had been upgraded in anticipation of the northern gas pipeline construction. All permanent materials required to complete the pipeline would be strategically stockpiled during the summer and fall of 1981 and winter of 1981-82.

The construction would be broken into six pipeline spreads, four to be completed by the winter of 1981-82 and the remaining two during the winter of 1982-83. Pumping stations would be constructed during the summers of 1982 and 1983, while maintenance depots, valve sites and communication facilities would, in general, be constructed at the same time as the adjacent pipeline; however, in some instances, summer construction might be employed. The Applicant indicated that the pipeline would be placed under cathodic protection immediately upon installation. The Applicant also indicated that measures would be taken to ensure the integrity of the pipeline during the period between installation and start-up.

The Applicant proposed to use conventional winter construction techniques with special measures to protect the pipe in areas of high potential settlement. These special measures would include the use of padding or loose native material to provide crush space for the pipe in the event of settlements. The Applicant proposed no special measures to crush, dry or store spoil for this purpose as it believed that the soil should be in an acceptable condition upon removal from the trench.

Construction workers would be housed in self-contained camps providing all necessary personnel requirements.

The Applicant was questioned on the effect the completion of the Mackenzie Highway would have on the construction of the pipeline. The Applicant responded that all construction plans and cost estimates were based on the permanent highway not being there.

5.2.4.2 Views of the Board. The Board finds that the proposed construction procedures are within the limits of conventionally available pipeline construction techniques. The Board believes that, given the relatively small diameter of pipe and the absence of overly sophisticated design requirements, the installation of the pipeline is technically feasible.

The Board, however, is concerned about several problems, unique to the area under consideration, that might arise during the construction of the pipeline. The shortness of daylight hours in the winter, the harsh climate, the difficulty of access to the right-of-way, the need for construction camps, and the sensitivity of the terrain are considered to be among some of the special problem areas. Should a certificate be granted, the Board would require that detailed construction procedures and specifications that address these special concerns be in place well ahead of any pipeline construction.

With respect to the scheduling of construction, the Board is satisfied that the time allotted for the completion of the project is reasonable and has taken into consideration the potential for delays that might arise during the actual construction. Although the estimated construction time appears reasonable in an absolute sense, the Board is not optimistic that all necessary authorizations and permits would be granted or that the additional studies leading to approval of final design would be completed in time for the construction to begin in accordance with the proposed timetable. The large number of environmental studies that the Applicant has undertaken to perform reinforces this view. The Board would require that a reassessment of the present timetable be made and that any modifications to the construction schedule and consequent effects on costs be submitted to the Board.

5.2.5 Operation and Maintenance

5.2.5.1 Evidence of the Applicant. The Applicant proposes to operate its pipeline in a manner similar to that utilized on the main IPL system. Its Edmonton office would provide all policy and procedure formulation, technical and environmental support, approval and implementation of all capital and operating budgets, as well as revision and updating of operating and maintenance procedure manuals. It would also oversee the general operation of the pipeline. The field division office, located in Norman Wells, would house the pipeline control centre and be generally responsible for the day-to-day operation of the system. The pipeline itself would be divided into three operating districts, each responsible for approximately one-third of the pipeline. District offices are proposed in Norman Wells, Fort Simpson, and Zama. It is proposed to use self-contained remote maintenance depots to provide more effective implementation of operation and maintenance procedures.

The pipeline system would be remotely operable from the Norman Wells control centre. All pumping stations, maintenance depots, remote valves and terminals would be

connected to this control centre. This would be done using a conventional computer assisted supervisory control similar to that found on other pipeline systems.

The Applicant proposes to use a sophisticated "transient" leak detection system which makes use of the computer, the control system and the three basic equations which govern the flow in a pipeline: continuity, momentum, and energy equations. Also included is the equation of state for the product being moved. The proposed peak detection system should be insensitive to transient effects such as those caused by flow changes, pumping starts and stops, and should detect a leak of as low as one-half of one percent of flow as well as provide an indication of its location.

Communications facilities would be provided by the local telephone companies, namely Northwest Tel and Alberta Government Telephones. Additional services would be required to prevent overloading of existing communications facilities. These services would be installed by the local telephone companies which indicated that they could be installed on time.

Under cross-examination the Applicant indicated that it had considered the use of line fill for fuel at the more remote stations. However, since crude oil requires elaborate engine designs to make it acceptable, and the NGL batches are off-specification and not usable without expensive upgrading facilities, it was considered uneconomical to use these products as fuel. The Applicant also considered using the pipeline to deliver diesel fuel to the stations but rejected this idea as too expensive because of fuel losses due to contamination. The Applicant now proposes to truck fuel to the Fort Simpson Station, to barge fuel to an unloading site near Wrigley, and to transship the fuel to the pumping station in an above-ground pipeline.

The Applicant also proposes to use diesel-powered electric generators at pumping stations and maintenance bases. Valves sites would be equipped with propane-burning generators. All would have a backup system.

The Applicant proposes to hire local residents for its pipeline crews where qualified personnel exist; otherwise it proposes to hire qualified personnel where they are available.

The Applicant was not in a position at the time of the hearing to provide the Board with detailed repair or maintenance procedures. The Applicant indicated that these procedures were not available because it had no operating experience in this region. It proposed to use the experience gained in the first construction season for developing procedures for operation and maintenance.

The Applicant indicated that it has contacted other companies operating pipelines in this area to determine what special conditions exist and what special measures or procedures are required for operation and maintenance. The specific concerns identified by the Applicant as a result of these discussions were primarily related to access, transportation, and working conditions. The Applicant has considered the types of transportation modes available for access to the right-of-way during both the summer and the winter months. Vehicles considered included both tracked and rubber-tired vehicles, amphibious vehicles and helicopters. No decision has been made yet on the type of equipment that would be used.

When questioned on the effects of spilled oil on permafrost, the Applicant responded that there would be a slight thickening of the active layer which would not be detrimental either in peat bogs or mineral soils covered with peat.

The Applicant indicated that the frequency of routine inspections would vary for different facilities. For pumping stations three routine visits per week, for remote maintenance bases weekly visits, and for valve sites monthly visits were considered adequate. At river crossings twice-yearly inspections were thought to be sufficient to maintain the integrity of the pipeline considering that a large number of functions would be monitored remotely.

The Applicant proposed to undertake a summer ditch and right-of-way maintenance program using borrow pits, remote maintenance bases, and valve sites for equipment and material storage. The purpose of this program, as stated by the Applicant, was to stabilize those areas where slumping had occurred due to winter construction, snow conditions, or ice content of soils.

Gravel or till material stored along the right-of-way would be hauled to areas where it was required. This program is also proposed to function as an erosion control program in critical areas. The Applicant did not have detailed procedures for this work.

In summary, the Applicant had considered the problems involved in operating and maintaining a pipeline in this region; however, it had not developed any detailed procedures nor did it feel capable of doing so at the time of the hearing.

5.2.5.2 Views of the Board. The Board believes that IPL (NW) has available to it the expertise and experience to implement satisfactory operational procedures for the proposed pipeline system. The Board is satisfied with the Applicant's proposed use of remote monitoring, computer-assisted control and leak detection systems.

The lack of adequate communication facilities in the NWT for use on the pipeline system is of concern to the Board. The Board would require assurances that proper services would be in place for both the construction and operational phases of the proposed pipeline and that present levels of service would not be adversely affected by the additional demands of the project.

It is the view of the Board that detailed and well-documented operation and maintenance procedures are essential for the proper operation of a pipeline system. This is particularly so when the pipeline is to operate in an area where access to the right-of-way is limited and where climate

and terrain sensitivities preclude the use of conventional maintenance procedures. The Board recognizes that experience related to the repair and maintenance of pipelines in the North is limited. The Applicant has indicated that it has no practical experience in this area and that it will rely on experience gained during the construction phase of the project to develop maintenance procedures. The Board also notes that the Applicant has given general consideration to emergency repair techniques, routine inspection procedures, and the use of summer and winter transportation vehicles.

The Board is satisfied that the Applicant has recognized the special problems associated with the operation and maintenance of the pipeline system. Although the Applicant has been unable to provide detailed operating and maintenance procedures, the Board is of the opinion that these procedures can be developed. The Board would require that an orderly evolution and development of detailed procedures be initiated by the company and that these procedures be submitted to the Board prior to line start up.

5.3 Cost of Facilities and Canadian Content

5.3.1 Cost of Facilities

5.3.1.1 Evidence of the Applicant. The Applicant estimated the total capital cost of the proposed Norman Wells pipeline to be $357 million.

The total estimated capital cost of these facilities was detailed according to Table 5.3.1

In the determination of the escalation component of $61 million, the Applicant stated that it had escalated the 1979 dollar cost base at a rate of 11 percent per annum to the appropriate year of expenditure for goods and services in accordance with the construction schedule presented in its application.

In the determination of the interest during construction (AFUDC) component of $62 million, the Applicant stated that it had calculated this amount using a rate of

TABLE 5.3.1

NORMAN WELLS PIPELINE PROJECT

Capital Cost Breakdown in Accordance with NEB
Oil Pipeline Uniform Accounting Regulations

Plant Account	Description	Estimated Costs ($million)	Materials, Supplies & Equipment	Construction Charges	Engineering & Management	Contingency
153	Pipe Lines	154	45.0	98.0	11.0	
156	Buildings	10	4.5	5.5		
158	Pumping Equipment	2	2.0			
159	Station Oil Lines	1	.5	.5		
160	Other Station Equipment	4	2.5	1.5		
161	Oil Tanks	1	1.0			
163	Communication Systems	6	3.0	3.0		
185	Vehicles and Other Work Equipment	5	5.0			
190	Engineering and Management	21			21.0	
	Contingency	30				30.0
	Escalation	61				
189	Interest During Construction (AFUDC)	62				
	Total Estimated Capital Cost	$357	63.5	108.5	32.0	30.0

12.6 percent per annum, compounded semi-annually, applied to the estimated yearly escalated construction expenditures.

Evidence adduced in the hearing indicated there are several factors which provide an incentive for the Applicant to construct the line with a minimum of cost overruns. First, Imperial has the right to audit all construction expenditures and may disallow any expenditures which are considered to be imprudently incurred. Second, the Applicant has indicated that as part of the normal management function, it is very concerned with cost overruns. Third, the Board has the authority, in establishing rates, to review capital expenditures. Finally, the most effective incentive is that Imperial is operating on a net-back concept of pricing whereby its net revenues from the Norman Wells field are affected by the tariff.

5.3.1.2 Views of the Board. The Board is satisfied with the total estimated capital cost of $357 million for this project. As well, the Board is of the opinion that IPL (NW) would have an incentive to ensure good cost control during the construction of the proposed facilities. For its own purposes the Board would require that IPL (NW) submit for Board approval project cost control plans and procedures.

5.3.2 Canadian Content

5.3.2.1 Views of the Applicant. With respect to its Canadian content policy IPL (NW) stated that IPL had encouraged Canadian industry in the past and, through its United States subsidiary had encouraged Canadian industry to export goods and services to the United States. The Applicant did not have written procedures to identify Canadian suppliers but took into account such factors as source of material inputs and manufacturing location. It was the Applicant's position that by dealing with the same companies used in previous projects, high Canadian content and industrial benefits could be achieved.

Although such considerations as timing requirements and price had to be considered in addition to Canadian

content, the Applicant's policy was to not purchase such equipment as valves and other specialized equipment offshore (presumably, if available in Canada); in fact, it was common practice for the Applicant to pay a small premium for Canadian goods and services other things being equal.

The Applicant also stated that it would give instructions to its contractors to use Canadian materials, equipment, and services whenever possible and that this practice would be consistent with its efforts to achieve high local participation. Although these procedures had not been detailed, the Applicant undertook to incorporate them in its construction practices.

The overall Canadian content was estimated to be 94 percent (total capital expenditure of $234 million, excluding interest during construction). Although preliminary, it was the Applicant's position that this estimate was reasonable.

The non-Canadian content portion of the proposed project consisted mainly of materials imported to produce line pipe and equipment required for construction and pipeline maintenance. Although of lesser importance in dollar terms, the pumping equipment was estimated to have a relatively high import content (about 60 percent) because of the need to import the diesel engines which are not manufactured in Canada.

The Applicant stated that line pipe would be obtained from either or both of the two major Canadian pipe manufacturers, that valves and fittings would be supplied from Canadian sources and that Canadian contractors would be used.

5.3.2.2 Views of the Board. The Board is satisfied with the analysis that IPL (NW) has conducted with respect to Canadian content and accepts the level of Canadian content estimated as reasonable. The Board notes, however, that the Applicant's estimate is preliminary and that the Canadian content achieved on this project could be different from that

estimated. Should a certificate be granted, the Board would request the Applicant to file a report with the Board, within twelve months after the granting of leave to open, indicating the Canadian content achieved in comparison to that estimated for each "NEB Plant Account" in Requisition No. 23, Appendix A of Exhibit 15, and the reasons for any variations.

5.4 Connecting Facilities

5.4.1 Evidence of the Applicant. The liquids that are to be transported in the proposed pipeline would originate at Norman Wells and would be produced by Esso Resources. Esso Resources proposed to separate the liquids into crude oil and natural gas liquids, cool them to the requisite temperatures, and tender them to IPL (NW) for transport to the markets.

At the Zama terminal the pipeline would connect with the facilities of the Rainbow pipeline system. The crude oil and natural gas liquids would then be transported to the Edmonton area. The Applicant testified that the natural gas liquids would be moved by a new pipeline from the Rainbow system to new cavern storage facilities to be constructed at Esso Resources' Redwater gas plant. At Edmonton, facilities are presently available to deliver the crude oil streams to the Trans Mountain Pipe Line Company and IPL pipeline systems. The Applicant indicated that both of these pipeline systems had adequate spare capacity to handle the Norman Wells projected volumes.

The present Rainbow pipeline system does not have the capability to handle the batches of NGL that the proposed pipeline would carry. However, the Applicant led evidence to the effect that Rainbow Pipe Line would be prepared to install the necessary facilities.

5.4.2 Views of the Board. The Board is satisfied that connecting facilities would be available to handle the crude oil and the products that are to be transported in the proposed pipeline.

CHAPTER 6
FINANCIAL MATTERS

6.1 Introduction

The Applicant led evidence on its overall financial responsibility including its proposed financial structure and method of financing. An essential component of the Applicant's ability to finance the pipeline is the "Norman Wells Pipeline Agreement."

This agreement is a three-party agreement between Imperial Oil Limited, Interprovincial Pipe Line (NW) Ltd., and Interprovincial Pipe Line Limited, and addresses financial and tariff matters. The provisions of the agreement that pertain to tariff matters are discussed in Chapter 12.

6.2 Evidence of the Applicant

6.2.1 Project Financing. The Applicant indicated in direct evidence that the project is structured so that it could be financed on a single project basis. The main feature of this type of financing is that a separate company is formed to own, construct, finance, and operate the project. The revenue from the project should be sufficient to meet all operating costs, debt service charges and repayment, as well as produce a return for the project shareholders.

IPL decided that the pipeline company should be a wholly-owned subsidiary for the following reasons:

(1) from a regulatory point of view it would be simpler because the proposed pipeline would serve a single shipper from a single oil field;

(2) because the project is located in a frontier area, the risks associated with it are different from those associated with IPL's present pipeline operations and consequently should not be shared by IPL's present users; and

(3) the proposed method of financing would not create a reduction of the debt capacity of the parent since the required credit support would be provided by the main shipper, whom the line is built to serve.

The financial witness for the Applicant stated that the project, given its size, the time frame over which the debt would be raised, and the credit support provided by the full cost of service tariff, could be financed within the context of the Canadian market. In making this statement the witness recognized that the two parties involved with this project have two of the strongest credit ratings in the Canadian market place.

6.2.2 Project Cost. The Applicant, through negotiation with Imperial, which is to provide the credit support, determined that a reasonable financial structure would be a 75/25 debt-equity ratio. If the project costs do not exceed the estimated $360 million, the capital structure of the company at the completion of the construction would be as follows:

	Amount ($ millions)	Percentages
Long-term debt	270.0	75
Equity	90.0	25
Total	360.0	100

It is also expected that cost overruns would be financed on the same basis. If there were substantial cost overruns, the Applicant indicated that some other financial structure might be selected. However, this would have to be negotiated with Imperial and was considered to be highly speculative.

6.2.3 Debt Financing. The Applicant's financial witnesses stated that debt financing could be raised either by a public or a private placement of securities in Canada. These conclusions were based upon the facts that the project would be relatively small in the context of the Canadian market, the time over which the debt is to be raised would be comparatively long, and credit support would be provided through the existence of a cost of service tariff and minimum bill which would ensure that the interest charges and principal would be paid. This type of credit support would be needed to meet the requirements of financial institutions who are likely to invest in the project, but who are restricted by legislation as to the type of securities in which they may invest. By issuing a first mortgage bond, the debt of the pipeline would be fully secured and eligible for investment by the financial institutions. Further, credit support would be provided by Imperial, a company with a "triple-A" credit rating.

The financial witnesses noted that the debt financing plan had not been finalized and that IPL (NW) would have considerable flexibility as to how it would finance the project. The Applicant stated that it would raise its long-term debt financing in such a way as to minimize costs.

6.2.4 Equity Financing. The equity financing that would have to be provided by IPL is about $90 million. The Applicant's financial witnesses stated that the intention of IPL was to finance the equity component from internally generated funds. Even if there were cost overruns, IPL did not expect to need outside financing, unless the overruns were substantial. In addition to its share of the initial capital cost to construct the pipeline, IPL might be required to provide operating funds to enable IPL (NW) to meet some specific situation for which IPL (NW) would not be able to raise funds.

6.3 Views of the Board.

The Board finds that the project financing approach as outlined by the Applicant is reasonable. It is satisfied that IPL has the ability to finance the equity component from internally generated funds, and recognizes that IPL (NW) would have considerable flexibility in financing the debt portion of the project. The general plan as outlined during the hearing would be acceptable. However, any certificate which might be issued would require that IPL (NW), before commencing construction, file with the Board proof that adequate financing was in place.

CHAPTER 7
ENVIRONMENTAL MATTERS

7.1 Construction Planning

7.1.1 Evidence of the Applicant. The Applicant stated that the proposed construction schedule would provide for the completion of the pipeline at least one full summer season prior to operation. This would allow for monitoring of the stability of the pipeline for a full thaw season prior to it being placed into service.

Any summer construction would be confined to pumping stations, maintenance facilities, the Great Bear River and Mackenzie River crossings and other work which could be carried out with minimal impact on terrain. The Applicant undertook to complete further studies on the two major river crossings scheduled for summer construction.

The Applicant would give due consideration to the concerns expressed by its consultants in planning its construction schedule; for example, the timing of construction activity between Norman Wells and the Blackwater River to minimize impact on moose migrating to and from winter range on the Mackenzie River islands; the timing of construction and barge traffic to avoid disturbance of waterfowl staging on the Mackenzie River during spring and fall migration; and the avoidance of disturbances to raptors during the nesting period in the vicinity of their nest sites.

CARC cross-examined the Applicant with respect to locations where it might be practical or acceptable to construct the pipeline when the ground would not be frozen. The Applicant testified that it was not proposing any mainline construction in the summer. The Applicant was further questioned on the effect on the construction schedule should regulatory permits not be received until the late winter of 1980-81 instead of 1 November 1980 as originally planned.

The Applicant replied that it would have to reduce the amount of time allotted to pre-clearing and it would be more difficult to integrate northern businesses with the main construction in the following year.

CJL cross-examined the Applicant with regard to the possibility of summer construction north of Fort Simpson. The Applicant testified that it had no plans to construct the mainline north of Fort Simpson during the summer but observed that there might be some tie-in work required during that season.

7.1.2 Views of the Board. The Board accepts the undertaking of the Applicant to incorporate into its construction scheduling the recommendations of its consultant to minimize environmental impact. The Board agrees with the Applicant that scheduling mainline construction for winter would minimize surface damage but that potential adverse impacts on mammals, fish and raptors would have to be mitigated. The Board notes that the Applicant would be conducting further environmental studies and has undertaken to incorporate the results into the development of its construction scheduling. The Board is of the opinion that the Applicant's environmental policies and procedures would effectively control the construction-related effects upon raptors, waterfowl, mammals and fish, recognizing that further studies would be undertaken to define site-specific mitigative measures. Should a certificate be granted the Board would require that, prior to commencement of construction, the Applicant file for Board approval a complete revised construction schedule including the specific mitigative measures to be developed and incorporated as a result of the further environmental studies.

7.2 Terrain Mapping

7.2.1 Evidence of the Applicant. The Applicant submitted environmental and geotechnical maps for its proposed route at a scale of 1:250,000 and, at the request of the Board, maps at a larger scale (1:50,000). In addition, the Applicant provided terrain maps and borehole information from the CAGPL project in support of the current application. In testimony, the Applicant indicated that it had drawn from all available data sources in the region in its assessment of the terrain, including terrain maps of the Geological Survey of Canada. The Applicant stated that it did not intend to prepare additional terrain maps since in its opinion no further field work was necessary at this stage.

7.2.2 Views of the Board. The Board is of the opinion that the terrain maps compiled for the CAGPL project and submitted in support of the application provided a description of the terrain adequate for the environmental assessment of facilities, construction activities and other activities which affect the terrain.

The Board notes that the geotechnical maps indicate where various terrain boundaries intersect the proposed route but do not show the areal distribution of terrain units and their relation to adjacent units.

The Board is of the opinion that terrain maps providing the detail of the CAGPL maps would be required along the Applicant's entire route and in areas of associated activities, that is, roads, borrow operations, stockpile areas, wharves, staging areas and other facilities and activities with impact on the terrain.

The Board further notes that the proposed pipeline follows fairly closely the CAGPL route for considerable distances, particularly that portion of the route from Fort Simpson to Zama Lake. However, the proposed route does diverge

from the areas covered by the CAGPL mapping in many locations and in some instances for long distances. This is especially true in the northern part of the route from Norman Wells to Wrigley, which is the portion of the route lying within permafrost, where sensitive soils predominate and where the Applicant indicated that additional field investigations to identify permafrost conditions, sensitive slopes, and areas requiring drainage and erosion control measures would be required. The Applicant stated that its design is most sensitive to terrain information in this area. From Norman Wells to Wrigley, approximately half of the route is covered by the CAGPL terrain mapping. The Board would require that the Applicant provide, prior to the commencement of any stockpiling, clearing, or construction-related activities, terrain mapping for those portions of the route not already covered by the CAGPL maps, and also for those areas where associated facilities or activities would be built or carried out.

7.3 Terrain

7.3.1 Evidence of the Applicant. The Applicant stated that it would minimize terrain disturbance in permafrost areas by maintaining the vegetative mat during clearing operations to minimize permafrost degradation. This would be achieved by scheduling pipeline construction during the winter months when the terrain is least sensitive, by hand-clearing on sensitive slopes, by using shoes on bulldozer blades to prevent disruption of the organic mat, and by using sleds when burning slash. By its original schedule it would have one year prior to construction on the right-of-way, thereby permitting thaw-sensitive soils to undergo settlement prior to construction. This would have reduced the likelihood of differential settlement and subsequent stress on the pipe.

To reduce the possibility of stress on the pipe and to mitigate terrain problems related to permafrost, two major concepts were incorporated in the pipeline design. The first was to make use of existing cleared rights-of-way as much as possible, as these areas have already undergone some thaw and settlement. The second was to operate the pipeline at ambient ground temperature to reduce the possibility of either thaw settlement or frost heave caused by the operation of the pipeline either above or below the temperature of the frozen ground.

With respect to the maintenance of the right-of-way during the operational phase of the pipeline, the Applicant indicated that it was not concerned with settlement resulting from the thawing of sensitive soils, unless settlement was "differential settlement" and gave rise to undue stress in the pipe.

IPL (NW) indicated that its monitoring program would be designed to detect differential settlements of 1 foot (30 cm) or more over a linear distance of 100 feet (30 m) and that remedial work would be undertaken if the integrity of the pipe were threatened.

The Applicant indicated that the major terrain problems would be related to thaw settlement, slope stability and drainage, and subsequent erosion in permafrost areas. No work had been carried out to delineate the extent or nature of these problems. The Applicant had, however, undertaken a three- week geophysical and soil-sampling program to delineate permafrost and the amount of permafrost degradation in discontinuous permafrost north of the Willowlake River. The results of this survey were not made available.

7.3.2 Views of the Board. The Board notes the Applicant's intentions to minimize terrain disturbance especially in areas of permafrost and on sensitive soils.

The Board also notes that the Applicant has not carried out studies to indicate where sensitive terrain and soils exist or where problems requiring mitigative measures or special construction procedures exist.

The Board further notes the Applicant's design philosophy of locating its pipeline on previously cleared right-of-way, of operating it at ambient ground temperatures, and of developing plans for remedial and rehabilitation procedures after having gained experience during the first year of construction.

In the Board's view the Applicant could have drawn upon the extensive plans and remedial and rehabilitation procedures that were developed by CAGPL and Foothills for the Northern Pipelines hearing.

It is the opinion of the Board that uncontrolled drainage on the right-of-way and the resulting erosion could be a major environmental problem. It is the Applicant's responsibility to maintain the right-of-way during the operation of this pipeline during all seasons of the year.

Should a certificate be granted the Board would require that the Applicant submit for Board approval a reassessment of its plans for minimizing terrain damage. This likely would require a reassessment of existing literature, additional field work with respect to route selection and river crossing sites, and the development of standard procedures for construction specifications concerning the maintenance of slopes and the terrain in general.

7.4 Use of Existing Cut Lines

7.4.1 Evidence of the Applicant. The Applicant proposes to use existing rights-of-way to the maximum extent possible in the northern portion of its route where permafrost conditions prevail. For example, the route would follow existing seismic lines and other previously cut lines where vegetation cover had been removed.

The Applicant stated that, because permafrost thaw settlement had already taken place in these areas, soils sensitive to thaw settlement would have had a number of years to drain, settle and adjust to their new thermal conditions. By routing the pipeline along these cut lines, the potential thaw settlement problems would be minimized. Therefore, every effort would be made to locate the pipeline on previously cleared land.

7.4.2 Views of the Board. The Board notes that the Applicant has pursued the "use of existing right-of-way" concept without full examination of its environmental implications or in some cases other possibilities for route location. For the most part seismic lines and other cut lines are only a portion (1/3 to 1/2) of the total width required for the pipeline right-of-way. Thus, additional clearing would be required to bring the "existing right-of-way" to the width of 20 m that the Applicant requires.

Soils on this widened portion of the existing right-of-way would be subject to thaw settlement in the same way as soils on entirely new right-of-way. The Board notes that the Applicant's proposed use of existing cut lines has caused it to exclude an assessment of actual soil conditions. The Board is of the opinion that in areas of discontinuous permafrost along the proposed route a further assessment of terrain types and soil conditions would be required in order to assist in the development of mitigative measures which would minimize the potential environmental impact resulting from thaw settlement.

7.5 Borrow Resources

7.5.1 Evidence of the Applicant. IPL (NW) provided information on quantity and quality of granular material and fill required for the construction of its facilities. It indicated that these materials would be taken from pits or

prospects which were previously investigated and reported on by others. A synopsis of the major environmental elements, concerns, and development recommendations were included in these reports.

The Applicant stated that these sources had not been subjected to any geotechnical or environmental field investigations, but that these studies would be carried out as part of its final design.

The Applicant indicated that it would, to the extent possible, make use of excess material from the pipe trench before opening borrow sources.

The Applicant stated that, with the exception of two pits which would require short all-weather roads temporary roads would be used to transport these materials. The Applicant did not identify which pits would be required for maintenance purposes during the operational phase of the project.

The Applicant stated that there would be only minor environmental impact from pit operations. The Applicant, in support of its appliction, submitted data from DINA's report series "Granular Materials Inventory" prepared by Pemcan Services. These reports contained a general assessment of material quantities and qualities and provided environmental highlights. General development and rehabilitation guidelines to minimize environmental impact were also given for each pit. In the case of pits 214 and 174, development was not recommended for environmental reasons, while development and rehabilitation restrictions were noted for many of the other pits.

The Applicant recognized the need for a complete geotechnical, development and environmental assessment of each pit and undertook to develop these prior to opening the pits.

7.5.2 Evidence of Intervenors. The GNWT accepted the Applicant's statements on the availability of granular materials. However, since there was no indication of volumes

of granular materials needed along the route, it was difficult to estimate the specific requirements of the Applicant. It was noted that one pit proposed for development by the Applicant should not be developed because of potential environmental impact.

7.5.3 Views of the Board. The Board is of the opinion that the Applicant's requirements for borrow material could be supplied from known sources and prospects. However, in some areas considerable haul distances would be required because of a lack of certain materials.

With respect to the use of local soil, the Board has some concerns should significant quantities of excavated material have to be disposed of, because of high ice content or poor grade.

The Board notes the Applicant's undertaking to carry out detailed rehabilitation and revegetation plans.

The Board also notes that although preliminary geotechnical and environmental data developed by previous investigators were submitted, the Applicant has not itself undertaken geotechnical and environmental assessments of borrow operations.

The Board further notes that the recommendations contained in the DINA granular materials reports have not been adopted by IPL (NW). The Board would require that they be adopted and implemented in the development of pits.

In addition, the Board notes the Applicant's undertakings to carry out further field investigations with respect to borrow operations and to make an environmental assessment of each site.

Should a certificate be issued, the Board would require that these assessments, the proposed mitigative measures and the rehabilitation procedures for each borrow area be submitted for Board approval prior to the commencement of clearing of any sites for development.

7.6 River Crossings

7.6.1 Evidence of the Applicant. The Applicant classified river crossings into three groups for design purposes: major, intermediate and minor. It stated that it intended to construct its major river crossings, which are the Mackenzie and the Great Bear Rivers, in the summer, while all other river crossings would be constructed in winter.

Consultants on fish and aquatic habitat recommended that the preferred time for crossing a number of the intermediate streams, namely Birch Island Creek, Blackwater River, Willowlake River, River Between Two Mountains, and the Petitot River, would be mid-summer. The Applicant stated that it intended to cross these rivers in the winter as the problems of access and terrain damage during summer were probably of a greater magnitude than the concerns about disturbing fish.

The Applicant indicated that further studies would have to be undertaken at river crossing sites to assess the suitability of the crossing with respect to terrain, geotechnical, and hydrological problems, and concerns related to aquatic life.

With respect to slope stability, particularly at river crossings, the Applicant indicated that this was an area which would require additional study.

The final location of the right-of-way at river crossings would be determined only after the studies had been conducted. At river crossings where clearing might be considerably wider than the normal right-of-way in order to provide working room, the Applicant indicated that it would not undertake pre-clearing due to the sensitivity of the areas.

The Applicant mentioned that no new concepts or design methods were required for river crossings and that it would use the data from the CAGPL reports.

7.6.2 Views of Intervenors. Intervenors expressed concern about the lack of site-specific designs for river crossings and about the possibility that the Board might approve the project before crossing designs were filed, a situation which might not allow intervenors an opportunity to make comments. Intervenors were concerned about the sensitivity of many of the valley slopes to thawing, about erosion and in some cases about the possibility of instability. They also felt that the impact of siltation caused by construction and possible erosion of adjacent slopes could have an adverse impact on fish and their habitat.

7.6.3 Views of the Board. The Board notes that the Applicant has not finalized its river crossing locations and that these locations would only be finalized after site-specific geotechnical and aquatic studies were completed.

The Board further notes that in many cases it may be necessary to relocate river crossings, owing to the environmental sensitivities of river valleys. This would only be known, however, after the results of field studies were available.

The Board would require that the results of the studies be submitted to the Board prior to construction. In addition, all the final locations and designs of river crossings would have to be submitted to the Board for approval prior to the commencement of construction.

7.7 Reclamation

7.7.1 Evidence of the Applicant. The environmental consultant for the Applicant established broad objectives for dealing with reclamation. These were to identify and evaluate means of stabilizing disturbed areas to control erosion and, after construction, to facilitate recovery to a natural cover of stable vegetation. A preliminary reclamation plan was included

in the application, which discussed the types of disturbances caused by the project and the types of procedures that could be used for reclamation. The Applicant tabled information on potential applications of seed mix for areas of low to high erodibility along the proposed pipeline route.

The Applicant testified that reclamation procedures, which would include those for any abandoned facilities, would be established following the first year of construction. These procedures would be undertaken on a site-specific basis. The Applicant undertook to file the final reclamation plan with the Board should the project be approved. The Applicant acknowledged the importance of revegetating erosion-prone sites, such as slopes at river crossings immediately after construction.

The Dene Nation cross-examined the Applicant's environmental panel with respect to the availability and desirability of using native seed exclusively for revegetation purposes. The environmental consultant testified that native seed would not all germinate in the first year or two, whereas the imported or cultivated varieties of grasses would. The consultant recommended native species as a second crop sown at the same time to ensure adequate erosion control.

7.7.2 Evidence of the Intervenors. CARC stated that inspectors should be present during the final restoration of the right-of-way to ensure that the proposed rehabilitation measures are followed. CARC also testified that detailed slope stabilization and right-of-way rehabilitation measures would need to be developed during the planning stages of pipeline development and shortly after final selection of the route.

7.7.3 Views of the Board. The Board notes the importance of reclamation procedures to ensure long-term terrain stability and mitigate environmental concerns resulting from terrain disturbance. The Board accepts the general reclamation

objectives established by the Applicant and notes the importance of scheduling and site-specific information for successful reclamation procedures. The Board also notes that the Applicant did not present a plan for the reclamation of sites disturbed by accidental spills of harmful materials. The Board would require that the Applicant file, for Board approval, prior to commencement of construction, a statement of reclamation measures to be taken in the event of accidental spills of fuels, lubricants and toxic chemicals. Further the Board would require, following the completion of the first winter of construction, a comprehensive reclamation plan for the right-of-way and for all other disturbed sites.

7.8 Archaeology and Historical Resources

7.8.1 Evidence of the Applicant. The Applicant acknowledged the importance of historical resource conservation, particularly in the Mackenzie Valley. The Applicant provided background information on heritage resources, indentified known resources along the route and rated sections of the proposed route on a scale of priorities for heritage conservation measures. General conservation measures regarding both existing and potential sites were outlined and included as recommendations. The Applicant undertook to implement the mitigation measures recommended by its archaeological consultant, which include:

(1) surveying the proposed route and making an inventory of the sites;
(2) assessing all discovered sites to determine potential significance; and
(3) avoiding or recovering by excavation, sites assessed as significant.

The Applicant testified that its archaeological consultant for Alberta considers that no further field work is required. The archaeological surveys recommended for the

Mackenzie Valley would be undertaken before construction commenced, with the more important sites to be checked before final route alignment.

Should an archaeological site be encountered during construction, operations would cease at the site until the area had been cleared. The Applicant accepted its archaeological consultant's recommendation to have archaeological crews accompany ditching and other construction or excavation activities to provide surveillance for any archaeological sites and proposed to include the other recommendations made in the consultant's report during route realignment.

The Dene Nation cross-examined the Applicant's environmental panel with respect to the contacts undertaken by the archaeological consultant during the course of its work along the proposed route, and the legislative requirements of the federal government for excavation of archaeological sites.

7.8.2 Views of the Board. The Board accepts the undertakings of the Applicant to implement the recommendations of its archaeological consultant and is of the opinion that they would be sufficient to mitigate the impact of the pipeline on historic and archaeological sites.

7.9 International Biological Program

7.9.1 Evidence of the Applicant. The Applicant testified that it had not had any discussions with the appropriate authorities regarding the interaction of its proposed pipeline project with the Brackett Lake IBP site. Should a certificate be issued, the Applicant would undertake to discuss with the organizations concerned with Brackett Lake the kind of monitoring program that they might wish to implement on the pipeline right-of-way.

7.9.2 Views of the Board. The Board notes the significance of the Canadian ecological reserves to the International Biological Program and accepts the Applicant's undertaking with respect to the Brackett Lake IBP site.

7.10 Wildlife Resources

7.10.1 Evidence of the Applicant. The Applicant provided a description of the existing conditions along the proposed pipeline route for waterfowl, raptors, other birds, and mammals. The assessment was based on a review of existing information on wildlife populations in the Mackenzie Valley and northern Alberta, a review of information on project design and scheduling, and consideration of potential interactions between project activities and wildlife populations. In August 1980, a survey of raptors' nests along the proposed pipeline route was conducted. The Applicant accepted the recommendations of its consultant to undertake further wildlife studies. The Applicant also undertook to visit all resource management offices of the appropriate governments before starting the survey to obtain the latest information concerning wildlife in a particular area. Potential impacts of the project on wildlife were categorized as follows: effects of habitat alteration, sensory disturbance, waste disposal, hazardous substances, and increased access.

To minimize alteration of habitat and creation of new access, the pipeline right-of-way, access roads and other facility sites would be located on previously disturbed areas whenever possible. The location of borrow pits would be established to avoid key habitats. The consultants concluded that the impact on wildlife populations due to habitat alteration would be very localized and would affect an insignificant proportion of wildlife populations.

Sensory disturbance of wildlife might result from blasting, mobile equipment and pumping stations. The Applicant undertook to plan blasting outside the critical periods for raptors and waterfowl. Aircraft would be restricted to minimum flight altitudes of 600 metres, with lower flight levels restricted by location and time of year. Pumping stations

would be designed and situated to take noise emissions into consideration. The consultant stated that the amount of habitat likely to be avoided by wildlife near pumping stations would be small. The Applicant undertook to draw to the attention of the barge company the concerns relating to staging waterfowl.

The consultant stated that proper waste disposal techniques along the pipeline route would minimize the creation of problems affecting mammals and it would consult with local authorities to determine the proper course of action to be followed. Fuels and other chemicals would be stored away from lakes, streams or other waterbodies and would be surrounded by containment berms.

CARC cross-examined the environmental panel with respect to recent changes in the distribution and abundance of wildlife population, the reliability of the data utilized by the consultant and the biological criteria used in evaluating alternative routes.

The GNWT cross-examined the Applicant regarding the information base for the wildlife assessment, the importance of Mackenzie River Islands for moose, the possibility of alterations to alignment and the location of facilities due to wildlife considerations, the establishment of access roads, aircraft disturbance, blasting, and the availability of the latest information concerning wildlife.

7.10.2 Views of the Board. The Board notes the Applicant's identification of potential impacts on wildlife and its proposed mitigative measures. The Board is of the opinion that the Applicant's environmental policies and procedures would reduce the potential impact on wildlife populations along the proposed route to an acceptable level. The Board also notes that further wildlife studies would be undertaken to verify mitigative measures and incorporate site-specific information.

The Board would require the Applicant to submit for approval, prior to commencement of construction, the reports on the additional field studies undertaken.

7.11 Aquatic Habitat and Fish Resources

7.11.1 Evidence of the Applicant. The Applicant stated that the proposed pipeline corridor had been the subject of numerous studies in relation to various development projects along the Mackenzie Valley. The consultant testified that much is now known about fish populations and other aspects of aquatic systems in the study area.

Following an assessment of the potential consequences of pipeline construction, the consultant stated that there would be some unavoidable effects on aquatic environments, but that the proposed pipeline should have no measurable, long-term effects on aquatic habitat or on fish populations in particular. The major effects of the pipeline on aquatic environments would be those that occur during the construction phase and immediately afterwards until a vegetative cover is reestablished. The consultant recommended that contingency plans be developed to ensure that any terrain instability that developed would be rapidly repaired. The consultant stated that during the operating phase, proper disposal of wastes, storage of stocks of fuel, fertilizer and toxic chemicals in safe, permanent locations would prevent damage from these sources. The Applicant recognized the concern for fish survival under siltation conditions and submitted that scheduling most of the mainline construction during the winter would minimize the concern. The two major river crossings, the Great Bear and the Mackenzie upstream of its confluence with the Liard, are proposed for summer construction. Further field work would be required to confirm the appropriate timing. The consultant recommended detailed site-specific studies of proposed pipeline-crossing sites and the locations of ancillary

facilities before finalizing the route and before commencing construction. The Applicant undertook to refine its knowledge of late winter conditions in some rivers in the vicinity of pipeline crossings.

Other potential adverse impacts on aquatic resources were identified by the consultant. These were: reductions in oxygen concentrations, spills of toxic chemicals, water withdrawal, culverts, oil spills, blasting and excessive angling. The Applicant undertook to follow the recommendations of its consultant with respect to oxygen levels with the exception of the requirement to re-aerate the test media. The Applicant testified that the test water would not pose a deoxygenation problem to flowing streams, because only limited volumes of test media would be required for the 12-inch (323.9 mm) line and the test water would be naturally aerated by flowing over organic terrain before reaching the stream. The Applicant further stated that the recommendations on toxic chemicals, water sources, culverts, oil spills and blasting would be implemented. The recommendations for regulating angling were considered inappropriate or unnecessary as major construction activities would be carried out in winter periods. The Applicant undertook to conduct a fish survey late in the winter of 1980-81 and an additional survey prior to construction so that any annual variation in the distribution of open water could be identified and changes in alignment made.

The Applicant testified that for testing purposes it did not plan to use methanol or any other freezing point depressant. There is a possibility that, following the testing and dewatering of the pipeline, there could be an additional pass of methanol to dry the line. The wash material would be collected in drums at the end of the test sections and disposed of using approved methods.

The Applicant's environmental panel was cross-examined by CARC with respect to government departments contacted during the aquatic resource studies, identification of critical areas and the adequacy of spill contingency plans.

The Dene Nation cross-examined the environmental panel with respect to the existence of information gaps for fish species inhabiting the streams of the Mackenzie Valley, the potential effects of oil spills on aquatic communities, the importance of the Great Bear River to grayling populations, the effect of blasting at the Great Bear River crossing, a list of fuels and toxic substances to be used during construction, operation and maintenance, the effects of turbidity on migrating fish and of equipment crossing flowing streams.

7.11.2 Evidence of Intervenors. CARC led evidence which stated that the environmental assessment identified most potential impacts on fish resources and fish habitats which could result from the project. However, CARC stated that the assessment did not provide sufficient detail on the project and its alternatives, the fish resources and fish habitat, the prediction of potential impacts of the project and its alternatives, or on the proposed mitigative measures or contingency plans. CARC's witness stated that the use of appropriate construction techniques, construction schedules, pipeline alignment and mitigative measures could reduce to acceptable levels many of the potentially adverse impacts of the project on fish resources and habitat if sufficient site-specific information were available.

7.11.3 Views of the Board. The Board notes the potential impacts on the aquatic habitat and fish resources which could result from the project as detailed by the Applicant and intervenors. The Board accepts the mitigative measures and the undertakings of the Applicant, including further site-specific studies, as capable of reducing the potential adverse impacts

of the project on fish resources and aquatic habitat to acceptable levels. Should a certificate be granted, the Board would require, prior to commencement of construction, that the Applicant file for Board approval the further site-specific studies which the Applicant undertook to provide as well as a description of the proposed mitigative measures to be adopted.

7.12 Raptors

7.12.1 Evidence of the Applicant. The Applicant has acknowledged the concerns associated with the disturbance of birds of prey and undertook to bring to the attention of the appropriate authorities, before the start of construction, any areas where potential impact might arise. Those aircraft flights with no specific requirements for low-level flying would be made at minimum flight altitudes of 600 metres. Flights at lower levels would require clearance from the environmental inspector and be governed by an environmental field manual outlining restrictions on low-level flights by location and time of year. The Applicant undertook to consider raptor nesting areas when locating the pipeline route, permanent facilities (for example, pumping stations) and temporary facilities (for example, contruction camps and borrow pits). A raptor nesting survey was conducted in August 1980, which recommended site-specific mitigative measures for potential impacts should the nests be within 3.2 km of pipeline associated activities.

CARC cross-examined the Applicant's environment panel on its concerns for the minimum distance that the pipeline should be built from raptor nest sites. CARC also questioned the Applicant on the potential for disturbing nesting raptors in close proximity to the line during routine aircraft patrols of the route.

The Dene Nation raised concerns with respect to raptors. The Applicant's environmental witness acknowledged that there was a concern regarding the possibility of

disturbance of early nesting raptors by construction activity. The Dene Nation expanded the scope of the disturbance problem to include the operational overflights. The question of jurisdictional responsibility for raptors in the Northwest Territories was also raised by the Dene Nation. The environmental witness for the Applicant testified that the raptor survey had been submitted to the GNWT Department of Renewable Resources.

The GNWT cross-examined the environmental witness with respect to the requirement for more detailed work on the raptor survey. The Applicant's witness agreed that it would be useful to identify the species which are occupying the nest sites identified in the survey. The GNWT raised the need for buffer zones around raptor nest sites. The environmental witness stated that a general buffer zone would not be adopted; however, if nests were within 3.2 km of activity, there should be a site-specific review and recommendations made to ensure that the impact would be minimized.

7.12.2 Views of the Board. The Board accepts the Applicant's undertakings to mitigate the impact of construction, operation and maintenance of the proposed pipeline on raptors. The Board notes that the Applicant has undertaken to involve the appropriate regulatory authorities in order to establish site-specific mitigative measures for raptor nest sites.

The Board would require, however, that the Applicant undertake to identify the species of raptors using the nest sites identified during the August raptor survey. This information would be required in order to incorporate the early (February) and late (April) breeding periods for various raptor species and a consideration of the endangered status of the peregrine falcon into the site-specific mitigative measures. The Board would require that the final program of mitigative measures for raptors be filed for Board approval prior to

construction. The Board is cognisant of the sensitivity of the information and feels confident that the Applicant would take adequate measures to ensure the confidentiality of this data.

7.13 Environmental Orientation

7.13.1 Evidence of the Applicant. The Applicant undertook to introduce an environmental awareness program to ensure that all personnel employed on the project were made aware of environmental concerns and the procedures for mitigating adverse environmental impacts.

The Applicant stated that an environmental procedure manual would be prepared. This would contain the site-specific environmental concerns and operational requirements for mitigating environmental impact. The Applicant had not yet developed this material, nor could it outline what would be contained in the manual.

The Applicant undertook to hold discussions with constuction contractors to explain the company's plans, procedures and undertakings for the protection of the environment.

7.13.2 Evidence of Intervenors. The GNWT felt that, with respect to the Applicant's orientation programme, it would want to have an input into the development and implementation of a training program, the training of a surveillance team and those who would be involved in conservation education efforts. Because of the lead time required to have staff in place, it would be unable to meet the Applicant's proposed schedule.

The Dene Nation expressed concern about the Applicant's timely implementation of the environmental awareness program since it had not yet been set up.

7.13.3 Views of the Board. The Board accepts the commitment of the Applicant to implement an environmental training and awareness program for personnel involved in the project and to

prepare an environmental manual to meet the site-specific concerns related to the project.

The Board notes that the Applicant has not yet developed an outline of what would be contained in its environmental procedures manual nor has it established the procedures or mechanisms by which this would be attached to contract documents or communicated to their contractors.

The Board would require that the Applicant's environmental awareness program and its environmental procedures manual be developed and submitted, for Board approval, prior to the start-up of construction or contruction-related activities.

7.14 Construction Inspection

7.14.1 Evidence of the Applicant. The Applicant stated that it would have a senior environmentalist on its construction staff who would have field representatives on all pipeline construction spreads to monitor construction on a day-to-day basis. The staff would report through their respective spread offices. The authority to give instructions or to shut down construction would rest with the spread office.

With respect to questions raised by intervenors on the environmental reports of the Ontario government "Environmental Study of the IPL-Montreal-Sarnia Extension" and "Sarnia to Montreal IPL-Field Observations" by the Environmental Protection Service, the Applicant stated that it would take into account many of the recommendations cited; however, it had not yet incorporated them into specific plans.

7.14.2 Evidence of Intervenors. CARC's witnesses expressed concern that the Applicant's environmental guidelines might not be rigorously enforced. It cited the example of IPL's construction of the Montreal-Sarnia line, where in its opinion communication problems and inadequate numbers of environmental inspectors were the principal reasons for inadequate environmental guideline enforcement.

CARC's witnesses expressed concern that IPL (NW), in preparing the environmental specifications manual, would not sufficiently detail some procedures, thus leaving too much latitude to the contractor for field decisions. It cited the construction of the IPL Montreal-Sarnia line as an example.

The GNWT also expressed concern about the environmental consequences of decisions made in the field and the necessity for on-site inspection by qualified personnel.

7.14.3 Views of the Board. The Board accepts the Applicant's undertaking to have environmental staff as part of its construction team. The Board further notes that the Applicant has not yet detailed the organization of its environmental staff, its functions, or its communication or reporting network.

The Board agrees with the intervenors on the importance of adequate inspection and the necessity for establishing special construction procedures to mitigate environmental impact.

Should a certificate be issued, the Applicant would be required to submit to the Board for approval the organizational structure of its environmental staff showing the staff qualifications, responsibilities and functions, their reporting network and the staff training program prior to commencement of any clearing or construction activities for the project.

7.15 Environmental Monitoring and Surveillance

7.15.1 Evidence of the Applicant. The Applicant undertook to inspect the right-of-way following construction and to carry out restoration work as required. The Applicant stated that the proposed pipeline would be patrolled by aircraft on a weekly basis. There would be two thorough inspections of the entire right-of-way each year for the first three years, which would include environmental and reclamation considerations. The Applicant proposed to undertake a remedial program of limited

trench backfill in the initial summer season following pipeline construction along each spread. This operation would also control erosion in critical areas where water might be diverted from the ditch line or right-of-way.

7.15.2 Evidence of Intervenors. CARC presented evidence based on the IPL Sarnia-Montreal project that recommended that regular monitoring studies be made to check the effectiveness of mitigative measures for all stages of pipeline development.

7.15.3 Views of the Board. The Board accepts the undertakings of the Applicant with respect to the environmental monitoring and surveillance of the proposed pipeline. The Board also is of the view that a comprehensive and coordinated monitoring program is necessary to maintain the integrity of the line and to ensure the success of proposed mitigative measures. The Board would require the Applicant to file for approval, prior to leave to open being granted, the complete monitoring and surveillance schedule proposed for the pipeline system.

7.16 Contingency Plans

7.16.1 Evidence of the Applicant. Under cross-examination, the Applicant stated that it would base its plans on its experience over the last 30 years of pipeline operation in southern Canada. It felt confident that it could develop such plans prior to the fall of 1983, before the start of operation. IPL (NW) submitted an outline of the proposed contingency plan. It did not submit a detailed contingency plan for oil spills, nor did it have specific plans for handling other project-related emergencies.

IPL (NW) stated, however, that the proposed line would be equipped with a leak detection system and that its on-line volume balance calculations would be able to detect leaks of 0.5 percent of the flow to within 10 km of a leak site.

The Applicant indicated that it would have oil spill equipment at the three pumping stations and at intermediate sites.

The Applicant stated that the clean-up of spilled oil would depend on the season and terrain and on the presence of ice on rivers and lakes. It briefly described what it would undertake to do on several terrain types. Recovered oil would be reinjected into the pipeline where possible. Contaminated oil and oil soaked mixtures would be burned.

With respect to the probability of an oil spill, the Applicant referred to IPL's operating record of the existing 12-inch (323.9 mm), 148 km line from Westover to Buffalo over a 16-year span and on the experience with the Lakehead line.

7.16.2 Evidence of Intervenors. In its evidence, CARC outlined the basic components of a contingency plan and what was required to prepare such a plan. It stated that such a plan should be prepared with a knowledge of the environmental sensitivities and described the Applicant's capability to protect these resources. Its witness stated that the Applicant needed to detail specific spill scenarios and counter-measure capabilities. It also felt that the preliminary work required to prepare a satisfactory oil spill contingency plan had not been done adequately.

In CARC's testimony major concerns were mentioned. Among these were: size of possible spills, leak detection, location of leaks in winter or in deep peat, capability to respond in winter or during freeze-up or break-up and availability of training and trained personnel.

In the absence of a contingency plan for oil spills, CARC felt that an adequate assessment of the environmental impact could not be made. CARC expressed the opinion that the Applicant's commitment to provide a contingency plan for oil spills prior to commencement of operation was inadequate.

In evidence the GNWT stated that the contingency plans should be part of the application and that providing the contingency plan prior to commencement of operation would be inadequate. It further stated that the contingency plans should be available at the application stage.

The GNWT stated that contingency plans were required not only for oil spills but also for hazardous chemicals, road construction and adverse weather conditions and their effect on the construction schedule and possible forest fires.

7.16.3 Views of the Board. The Board notes that IPL (NW) undertook to provide detailed contingency plans prior to the start of operation of its proposed pipeline.

The Board would require the Applicant to provide, for review and approval, its contingency plans regarding, inter alia, the handling and storage of fuels, lubricants and toxic chemicals, forest fires and changes in construction scheduling. The Board would have to be satisfied on these plans before it would allow construction to proceed.

With respect to contingency plans relating to product spills during pipeline operation, the Board would require that these be provided for approval prior to leave to open being granted should a certificate be issued.

7.17 Further Environmental Studies

7.17.1 Evidence of the Applicant. The Applicant stated that the additional field investigations recommended by its consultant would be undertaken prior to final design and construction. These investigations would determine the routes of access roads and the location of borrow sites to minimize disruption of wildlife habitat.

The Applicant acknowledged that a considerable amount of detailed field work would have to be done prior to the start of construction. The Applicant undertook to carry out such

work and testified that there was sufficient time to accomplish the studies prior to the scheduled start of the main construction.

The Applicant stated that office studies such as monitoring programs, contingency plans and operation and maintenance procedures would be provided to the Board prior to start-up.

The Applicant further stated that field studies on archaeology, slope stability, thaw settlement and borrow pits would be done concurrently with project development.

7.17.2 Evidence of Intervenors. CARC expressed concern with respect to the adequacy of the Applicant's environmental work. It was CARC's view that sufficient detail was not provided on the project and its alternatives, the prediction of potential impacts, the proposed mitigative measures, or on contingency plans.

It was CARC's opinion that the Applicant had not spent sufficient time in preparing its assessments, had not done required site-specific field work and in general had not presented its case for review.

CARC felt that the Applicant's environmental assessment was seriously deficient in many areas. Further, CARC found it difficult to rely on the Applicant's good intentions to supply adequate levels of information since the Applicant had failed to demonstrate these intentions by preparing a thorough environmental impact assessment. CARC submitted that the Applicant had not adequately made its case, and therefore suggested that the issuance of a certificate should be withheld until the Applicant had demonstrated its ability to construct and operate the pipeline in an environmentally acceptable manner.

The Dene Tha' Band stated that it had a close relationship with the environment and that its concerns had not been adequately dealt with due to the lack of environmental information.

It also stated that the outstanding information should be filed as part of the application so that intervenors might be given the opportunity to assess the information and determine whether the Applicant would take adequate measures to minimize negative environmental impact.

The GNWT indicated that they were not satisfied with the degree of information provided by the Applicant, particularly with that relating to contingency plans.

The GNWT pointed out the desirability of having the chance to review additional information and feared that intervenors might not have the opportunity to review additional information submitted to the Board either after the hearing phase or following certification of the project.

7.17.3 Views of the Board. The Board accepts the Applicant's undertaking to provide additional detailed information based on further design work or additional studies.

The Board notes that a considerable number of additional site-specific studies are required in many areas to establish environmental conditions, develop mitigative measures and establish maintenance and rehabilitation procedures.

Should a certificate be issued, the Board would require that IPL (NW) submit for Board approval, within two months after certification, a comprehensive schedule for filing with the Board those studies, programs, plans and procedures which IPL (NW) undertook during the hearing to carry out. The Board would also require the Applicant to forward the schedule concurrently to the intervenors of record at the hearing of this application.

IPL (NW) would be required to serve, concurrent with each filing with the Board, a copy of each study, program, plan or procedure on each intervenor of record who advises IPL (NW) of its desire to see the material. The Board would require IPL (NW) to develop a consultative mechanism for those parties wishing to comment on the material in order that the final

design as reflected in the construction contract specifications and the environmental procedures manual would take into consideration such comments.

IPL (NW) would be required to serve, concurrent with each filing with the Board, a copy of the construction contract specifications, environmental procedures manual, the environmental education program and environmental inspection program on each intervenor of record who advises IPL (NW) of its desire to see the material. At the time of the filing of such material the Board would establish procedures to be followed by those parties wishing to comment on the documents. The Board would consider applications from IPL (NW) for orders providing for relief from the requirement of serving on intervenors certain documents or portions thereof provided adequate reasons were given.

CHAPTER 8
REGIONAL SOCIO-ECONOMIC IMPACTS

8.1 Introduction

Most of the socio-economic impacts likely to result from the proposed project would be expected to occur within a corridor starting at Norman Wells, extending southeast along the Mackenzie River to a point east of Fort Simpson, following the west side of the river and bending towards Zama Lake in northern Alberta. This corridor generally encompasses areas and communities within some 120 km of either side of the pipeline route. Communities within or near this corridor could supply manpower, goods or services to the proposed project and are most likely to experience direct project-related impacts. Communities such as Yellowknife, Hay River and Enterprise, while excluded from this direct impact corridor, still fall within the project's broader impact area.

Of the total population of some 21,500 people in the entire impact area (1978), 17,500 reside in the Northwest Territories and 4,000 in northern Alberta. In the Northwest Territories, approximately 60 percent (10,500) of the impact area's population resides in Yellowknife and some 20 percent (3,500) in Hay River and Enterprise. About 35 percent of the impact area's population in the Northwest Territories is of native origin. In northern Alberta, half the population of the impact area resides in High Level and about 30 percent of the population is of native origin.

Focusing on the impact corridor in the Northwest Territories, approximately 4,000 people live within this narrow land area and some 75 percent of these are of native origin. The remainder, of non-native origin, reside predominantly in Fort Simpson and Norman Wells.

The economic activity of the impact area is narrowly based. Its major components include the public sector, the mining and the oil and gas industries, the renewable resource sector and a modest manufacturing, tourism and service sector.

8.2 Evidence of the Applicant

8.2.1 Information, Consultation and Liaison. The Applicant recognized the importance of making project-related information available to all interested parties on a timely basis. Should the project be approved, the Applicant would be developing comprehensive information programs to inform governments, local community bodies, northern residents and other interested groups about all aspects of the project that are likely to be of interest or concern to them.

Prior to the hearing, the Applicant had conducted some 45 community meetings. The Applicant chose not to involve its regional socio-economic consultant, Resources Management Consultants (Alberta) Ltd., in these meetings arguing that it would ultimately be the Applicant's responsibilitiy to ensure that community information and consultation would be ongoing for the duration of the project. The objective of the community meetings, from the point of view of the Applicant, was not to solicit the communities' opinions on whether they would like to see a pipeline built, but rather to inform the population about the proposed project and to improve upon impact management strategies.

8.2.2 Impact on Employment. IPL (NW)'s basic employment policy with respect to the construction and operation of the pipeline is to maximize employment opportunities for northern residents, and it proposes to implement a number of programs to ensure that local residents have advance information about, and have the opportunity for project employment.

The proposed combined projects are expected to require an average of 284 workers per month for fieldgate facilities construction and 241 workers per month for pipeline and pumping station construction over a 34-month construction period. The combined manpower requirements are expected to peak at 1,344 workers during the second winter construction season. Labour demand would lie between 300 and 800 workers for 18 of the 34 months.

With respect to the operations and maintenance phase, the Applicant stated that the pipeline would create 29 full-time permanent positions of which 16 would be in Norman Wells, 9 in Fort Simpson and 4 in Zama City. An additional 121 people would be required for the maintenance and operation of the expanded producing fieldgate facilities. The Applicant viewed these areas as offering the most promising long-term employment opportunities for local residents.

In addition to the direct employment generated by the combined projects, the consultant estimated that indirect employment could reach 180 jobs during construction and stablilize at 65 jobs during the operations phase.

The Applicant estimated that during construction of the combined projects, some 150 of the 525 average monthly manpower demand could be met by Northerners. For the operations and maintenance phase, it estimated that 60 of the 150 permanent positions could be staffed by Northerners. These figures were viewed as conservative because the current rate of participation by Northerners in existing jobs at Norman Wells was already greater than that projected by the consultant for the combined projects.

The Applicant also expected that specialized manpower requirements for mainline construction would be primarily imported (from the south) and that northern labour participation would be largely derived from pre-construction and spin-off work via the involvement of northern contractors. As well, the Applicant stated that these contractors would be obligated to maximize the use of local manpower.

The Applicant did not intend to provide any training (other than on-the-job training in Esso Resources' case) for the skilled labour required on the construction phase of the project. Rather, its northern resident training programs would focus on the operations and maintenance phase.

Esso Resources indicated that it would be recruiting from the entire western Arctic. IPL (NW), on the other hand, planned to recruit northern residents primarily from

communities in the immediate vicinity of the pipeline during construction. For the operations and maintenance phase, however, IPL (NW) would recruit from throughout the Northwest Territories.

Should a certificate be granted, the Applicant would undertake to prepare and implement both a "Northern Resident Training and Employment Action Plan" and a "Manpower Recruitment and Delivery Plan." The Applicant would also undertake to provide and implement an orientation program for all operations and maintenance employees. In addition, contractors' manpower requirements and schedules would be provided to government agencies and other interested groups on a timely basis prior to the beginning of construction.

8.2.3 Impact on Local Business. As a general policy statement, IPL (NW) stated it would stimulate business opportunities and would be committed to communicating the need for and would establish a preferred position for northern businesses with respect to such opportunities.

It proposed to prepare a "Northern Business Opportunities Plan" which would identify and analyze potential business opportunities, disseminate opportunities and tendering procedures information, establish and maintain an up-to-date northern bidders list, and provide adequate lead time for northern businesses to tender on contracts.

The Applicant also undertook to include in this plan consideration for factors such as the small size of northern operators, distant suppliers, low capitalization, etc. On this point, the consultant indicated that much of this work still remained to be done.

IPL (NW) anticipated that northern businesses would participate mainly in the initial work (such as clearing), the spin-off type of work (such as road maintenance, expediting, and local transportation and civil works), and in the operations and maintenance phase. IPL (NW)'s consultant estimated that the potential for northern business

opportunities would be in the order of $21 million during the construction period and could total $2.3 million and $200,000 annually for Norman Wells and Fort Simpson, respectively, in the longer run. IPL (NW), on the other hand, estimated the potential for local business opportunities during construction of the pipeline to be in the order of $50 million ($1979) in the Northwest Territories and close to $8 million ($1979) in northern Alberta. For the operations phase, IPL (NW) anticipated direct annual expenditures could reach $5 million ($1979) in the Northwest Territories and $0.6 million ($1979) in northern Alberta.

8.2.4. Impact on Population. An estimate of potential population impacts resulting from the combined projects was submitted with the proviso that it provided order of magnitude approximations, only to be used for preliminary assessment and planning purposes.

IPL (NW)'s consultant indicated that the population impact of the combined projects' construction phase would be both larger and more wide-spread than that associated with the operations and maintenance phase. It was also pointed out, however, that this construction phase population impact would be of a short duration. It was expected by the consultant that the combined projects' construction would attract slightly less than 300 people to the impact area, of whom about one-third would be located in Norman Wells, and the remainder distributed between Yellowknife, Hay River, Fort Simpson and to a lesser extent, Zama City. The consultant viewed the increase in Norman Wells to be significant.

During the operations and maintenance phase, the consultant estimated the permanent population increase in the Mackenzie Valley to be about 230 people. With some 70 percent of these establishing residence in Norman Wells, excluding 75 rotational operations and maintenance workers located in Norman Wells, this represented an increase of 60 percent over current population levels. Other permanent population increases would be distributed between Fort Simpson and Zama City.

8.2.5 Economic Impact

8.2.5.1 Overall Economic Impact. The Applicant was of the opinion that the combined projects would provide considerable economic benefits to the Northwest Territories particularly during the construction period. During the operations and maintenance phase, it anticipated that the combined projects would not significantly alter the basic economic structure of the Northwest Territories. In addition, it was stated that the combined projects would be a major contributor to economic growth and would provide economic benefits to the Northwest Territories at a time when the region appeared to be experiencing a lack of real economic growth.

Notwithstanding this, IPL (NW)'s consultant believed that, solely from a regional perspective, the economic impact of the combined projects was likely to be small, even during construction.

The Applicant's consultant indicated that there would likely be some upward pressure on prices and that this was more likely to occur during the construction rather than the operations and maintenance phase of the combined projects.

8.2.5.2 Sectoral Economic Impact. During the construction and operations and maintenance phases, the consultant felt that the forestry, trade, construction and service sectors, and the sand and gravel portion of the mining industry would experience a number of impacts both in the Northwest Territories and northern Alberta. The project was expected to stimulate additional oil and gas exploration activities. The effects of attracting or diverting Northerners from jobs in other sectors would also likely be felt in all sectors of the regional economy.

8.2.5.3 Impact on Transportation and Communications. IPL (NW)'s policy on matters of transportation and communications was to avoid placing unacceptable traffic loads on the impact area's systems. Both IPL (NW) and Esso

Resources indicated that if the combined projects' shipping needs were identified as conflicting with an essential non-project demand, then they would place priority on ensuring that the non-project demand received priority treatment. Overall, the combined projects were not expected to tax existing transportation and communication systems with the exception of some possible short-term overloading in the trucking industry and the telephone system.

8.2.5.4 Impact on the Government Sector. Both Esso Resources and IPL (NW) believed that the proposed developments would be a significant source of revenues contributing toward economic self-sufficiency for the Northwest Territories. As for northern Alberta, it was expected that impacts on government at both regional and provincial levels would be small because of the project's small size and because these governments have had considerable experience with pipeline projects.

8.2.6 Impact on Renewable Resource Harvesting by Native People

The Applicant recognized both an economic and a socio-cultural dimension to renewable resource harvesting by native people. While trapping, fishing and gathering activities did not represent a major source of employment or income at the regional level, the Applicant recognized the importance of such activities for native people in small as well as large communities. In its view, such activities could represent as much as 50 percent of native people's total income (cash and non-cash).

IPL (NW)'s policy on matters relating to these activities was to endeavor to protect areas identified as having cultural or resource harvesting importance to Northerners. This policy included a commitment to work with the appropriate parties to avoid, whenever practical, damaging or precluding the seasonal use of such areas, and a commitment to make project employees aware of these concerns.

The consultant further mentioned that it did not view the combined projects as having a significant effect on renewable resource harvesting activities and could, depending on the response to rotational job opportunities, result in a net positive effect.

8.2.7 Some Aspects of Social Impact and Community Impacts. The Applicant's consultant believed that the social effects of the combined projects would be directly related to the characteristics of the various communities involved. Communities in the impact area could be divided into two groups. One group including Yellowknife, Hay River, Norman Wells and Fort Simpson, represented the larger, more acculturated settlements which have significant white populations and considerable previous exposure to industrial development activity. The second group was comprised of smaller, predominantly native communities with much less experience with, and exposure to, acculturative influences. It was felt that these communities were the most sensitive to any negative social impacts resulting from development activities.

IPL (NW)'s consultant pointed out that the nature of the combined projects' plans and mitigative policies was such that the bulk of project activities, and virtually all of the population effects, would occur in and around the larger, more acculturated and less sensitive communities, thereby limiting the potential for adverse social impacts.

To minimize social and community impacts, the Applicant proposed to work closely with all parties concerned to ensure that the project did not place an unacceptable load on regional health care systems, on security and law enforcement, and on existing referral counselling services throughout the impact area.

In relation to Fort Simpson and Norman Wells, however, the Applicant's consultant felt that the combined projects' construction activities would cause socio-cultural impacts due primarily to contact between local residents and

southern workers. The consultant was of the opinion that the Applicant's proposed mitigative policies might help control, but would not eliminate, these concerns. Smaller native communities were expected to experience some increase in alcohol-related problems, heightened child welfare problems, an increase in the criminal offense rate and other social problems.

In terms of the operations and maintenance phase, it was anticipated that Norman Wells would experience the most pronounced social and community impacts primarily due to the proportionally large population increase. In smaller communities, it was anticipated that the operations and maintenance phase would not be as significant in terms of socio-cultural impacts since rotational employment should eliminate the need for migration and would allow workers enough time at home to maintain their existing socio-cultural patterns.

Impacts on northern Alberta would be similar in nature to those occurring in the Northwest Territories but were expected to be smaller.

8.2.8 Other Matters

8.2.8.1 Monitoring. IPL (NW) indicated it would develop and implement procedures for monitoring and reporting on the socio-economic effects of the project during construction and the initial years of operations and maintenance, and would cooperate with other monitoring programs instituted by local or other government bodies.

8.2.8.2 Compensation. IPL (NW) indicated it would compensate individuals for losses suffered as a result of construction, operations or maintenance of the project. IPL (NW) also stated it would work closely with government and other appropriate parties to develop and implement a practical and workable system of compensation prior to the beginning of construction. It would also review this system

with government and other appropriate parties on a regular basis during all phases of the project.

8.2.8.3 Impact of Project on Local Energy Use. IPL (NW) stated that a genuine concern expressed by communities during the community meetings centered on the cost of energy in these communities. IPL (NW) did not, however, have any plans to supply oil to communities along the pipeline route.

8.2.8.4 Position on Settlement of Land Claims and Aboriginal Rights. Although IPL (NW) recognized the concern as expressed with respect to land claims, it did not view their settlement as a pre-condition to proceeding with the project. Instead, it believed that both the project and land claim negotiations could proceed separately and concurrently. However, IPL (NW) did agree that in the absence of such a settlement there might be less local participation in the project.

8.2.9 General Position on Regional Socio-Economic Impact. IPL (NW) stated that should the Board require as a condition of a certificate prior approval of the socio-economic plans recommended by its consultant, that it would be prepared to file such plans with the caveat that they cover the "key elements" of their programs rather than all the details. Its consultant stated that it considered these to be important elements in securing the benefits projected for the impact area.

IPL (NW) indicated that it considered the views of local elected representatives as important to the determination of the public interest aspect of the project. Its own view was that the project was both in the regional and national interests.

IPL (NW) believed that its project, in contrast to the Mackenzie Valley gas pipeline, was much smaller in scope and would result in less disruption.

IPL (NW)'s consultant also believed that the project would offer much needed economic opportunities to residents of the study area and would be of a scale which would preclude the wide reaching socio-economic disruptions often associated with so-called mega-projects located in a sensitive human environment such as that which currently exists in the North. They believed that the long-term benefits of the project would far outweigh its costs and that those short-term problems which would occur would be manageable.

8.3 Evidence of Intervenors

8.3.1 Alberta Chamber of Resources. The Alberta Chamber of Resources was of the opinion that the proposed project should be approved because it offered tangible social and economic benefits such as increased oil supply, improved balance of payments, and job and business opportunities to both Canada and the impact region. The witness for the Alberta Chamber of Resources adduced evidence showing that this position was also adopted by the City of Edmonton.

8.3.2 Canadian Arctic Resources Committee. CARC held the view that several fundamental public interest issues must be resolved before any pipeline project in the Mackenzie Valley could be approved. It listed these issues as the settlement of Dene land claims, the need for a land-use plan in the Mackenzie Valley to mitigate impacts associated with an energy corridor, and the need for the North to share more fully in the proposed project's benefits. CARC indicated that it was not opposed to the project in principle, but rather to the fact that approval at this time would impair the ability to deal with these issues.

CARC argued that the delay recommended by Mr. Justice Berger should be adhered to because the reasons for the proposed delay still exist. CARC did not share the Applicant's view that comparison of the IPL (NW) project with the previous Arctic Gas proposal was inappropriate, arguing instead that the

shape and size of industrial development did not alter the native people's beliefs nor their desire for self-determination.

CARC noted that the scale of the project would require consideration of the corridor concept, regional planning procedures, good monitoring and management of impacts. It was also of the opinion that although the Mackenzie Valley had already seen some development, the proposed IPL (NW) pipeline, more than any development that has been completed to date, would shape and influence the evolution of an energy transportation corridor in the Mackenzie Valley.

8.3.3 City of Yellowknife. Although the City of Yellowknife welcomed the potential opportunities of the proposed project, it felt that many details had yet to be worked out between the Applicant, the territorial and federal governments, and various interest groups before maximum benefits from the project would accrue to Northerners. It stressed the need for the Government of Canada to respond to the project-related concerns of the GNWT and indicated it would withold its support until this was done. As well, the City of Yellowknife indicated it would require guarantees of meaningful participation for local businesses and northern residents as well as a guarantee of reliable, reasonably priced, future regional energy supplies.

8.3.4 Committee for Justice and Liberty Foundation. CJL opposed the project on the grounds that it would benefit neither Canadians nor residents of the Northwest Territories.

CJL argued that the lack of resolution of land claims meant that any decision affecting these lands would be an example of federal government lawlessness and of failure to negotiate in good faith with the Dene. National interest in promoting cultural diversity and social justice were also cited as reasons for rejecting the IPL (NW) application.

From a regional point of view, CJL's emphasis was on the "major blow which the pipeline would constitute to native

claims." It believed that proceeding with the pipeline at this time would prejudice Dene land claims by denying the Dene the political right to decide, to have institutions in place at an appropriate time, to negotiate with the companies, to plan and strengthen their economy prior to non-renewable resource development, and to have a full range of choices for land selection. It was also CJL's contention that the socio-economic study done by the Applicant's consultant was inadequate, particularly in terms of field work. It believed that the pipeline would provide few jobs and would act as a catalyst to further development.

8.3.5 Dene Communities. As part of the case presented on behalf of the Dene Nation, representatives and chiefs from most Mackenzie Valley communities from the Mackenzie Delta region to the area around Great Slave Lake and Fort Smith, presented the views of the native people to the Board. They agreed that the proposed project should not proceed until questions of land claims and aboriginal rights were settled. The size of the pipeline was not viewed as an important consideration. They pointed out that the Dene people had not benefited from past developments. Therefore, they felt they could not agree to further development until they had control over such developments.

They also explained the relationship between the Dene people and the land as well as the differences between Dene and non-Dene values. They felt that the land had to be protected since it was "their bank" and ensured their survival.

The representatives and chiefs felt that all had been said to Mr. Justice Berger a few years ago. Nevertheless, they believed that the issues raised by the proposed project were sufficiently important for them to appear before the Board despite the fact that they should have been out on the land.

8.3.6 Dene Nation. The Dene Nation believed that it was not in the interest of the Dene for the proposed project to proceed

at a time when current priorities in the North were to settle aboriginal rights and to determine the type of government they wanted for the North. Under present conditions, the Dene Nation believed that the proposed project would open the way to further development and would add to existing problems in the North.

The view was also held that Mr. Justice Berger's ten-year moratorium should be applied. Having expressed all its views to Mr. Justice Berger, the Dene Nation questioned the need for the Board's hearing on the IPL (NW) project.

The Dene Nation indicated that they were not against development per se, but rather that they wanted to ensure that maximum benefits would accrue to the Dene when resource development occurred. The Dene Nation pointed out that the non-Dene were well-cushioned against the negative socio-economic impacts resulting from development, while the Dene were not.

8.3.7 Dene Tha' Band. This Band was of the view that the project would have serious implications for the lands, lives and resources of the Dene Tha' people. It anticipated that the impact of the proposed project would be no different from the usual negative effects of development in general.

The Dene Tha' Band stated that some 24 terms and conditions had to be met before they could support the proposed project. These touched upon such matters as compensation, employment, orientation-counselling, alcohol consumption, monitoring, access to communities, etc. Briefly summarized these were: that the Band (and its members) be assured that a fair and adequate compensation program would protect the economic life of the Band in general and trappers' incomes in particular; and that guarantees be given to the Band for specific and meaningful business contracts for actual pipeline construction and related activities. They also argued that both of the above should be in place prior to approval of the project.

The Dene Tha' Band also held the view that the socio-economic data base on the northern Alberta portion of the impact area was "deficient, inaccurate and out-of-date." They suggested that without a new socio-economic impact study, it would be impossible to predict with any accuracy the possible impacts, whether positive or negative, this project might have on the Band.

8.3.8 Government of the Northwest Territories. The GNWT's conditional support of the proposed project was in relation to the five concerns developed in concert with the Métis Association and the Dene Nation mentioned later. In terms of the preparation of a long-term plan in the Northwest Territories, it stated that although proceeding without such a plan might be in the national interest, it might foreclose the best options for renewable resource development which are of local and regional interest.

The GNWT further stated that, to date, it had not received either confirmation or rejection of the five conditions from the federal government.

Further, while the GNWT recognized that the project would offer various opportunities to northern residents, it also felt that if these five points of concern were addressed prior to project approval the gains to northern residents from the project could significantly increase.

8.3.9 Hay River and Area Economic Development Corporation. The Hay River and Area Economic Development Corporation was of the opinion that the proposed project would diversify and strengthen the area's economic base and hence would result in significant economic benefits to Canada, Alberta and the Northwest Territories. It did indicate, however, that it would like guarantees or very strong assurances that northern people would get every opportunity to participate in the proposed project.

8.3.10 Inuvik and District Chamber of Commerce. The Inuvik and District Chamber of Commerce supported an early decision for the construction of the Norman Wells pipeline. It submitted that there would be direct economic benefits for local residents through employment, business opportunities and spin-off effects such as an increased level of services in the Mackenzie Valley communities. In addition, it believed that the increased oil production from Norman Wells would contribute to the national energy policy of self-sufficiency as well as supply territorial needs. It also maintained that the approval of the project would assist the settlement of native claims in the Mackenzie Valley. It also contended that, should the Norman Wells project be approved quickly, it would provide the impetus needed for subsequent use of the Mackenzie Valley for the transportation of oil and gas from the Mackenzie Delta and Beaufort regions.

8.3.11 Métis Association of the Northwest Territories. The Métis Association withheld support for the proposed project pending federal government acknowledgement and action upon the five points jointly submitted by the Dene Nation, the Government of the Northwest Territories, and the Métis Association. These five points were:

(1) the need to formulate a long-term plan for the development of non-renewable resources in the Northwest Territories;
(2) the requirement for a northern based authority to control and regulate development to adequately serve the interests of the people of the Northwest Territories;
(3) the requirement for a plan for the sharing of royalties;
(4) the requirement for policies and programs to ensure the availability of energy supplies to meet the present and future needs of Northerners; and,
(5) the requirement for some movement in the area of aboriginal rights and claims.

To the time of the hearing, the Métis Association indicated it had received no evidence of action on these five points.

While the Métis Association recognized that the project might be in the national interest, it felt it could not support the project until it had evidence that it would be in the regional interest, in the broadest sense.

8.3.12 NWT Grade Stamping Agency. The Agency supported the proposed project subject to the condition that Northwest Territories forest products suitable for use on the project be given first consideration, with an attendant commitment that employment for local people would be given first priority.

8.3.13 Town of Inuvik. The Town of Inuvik viewed the immediate development of the Norman Wells oil field expansion and pipeline project as a step towards revitalizing the depressed economy of the Mackenzie Valley and paving the way for economic self-sufficiency for the Northwest Territories.

It believed that the objectives of the Government of the Northwest Territories could and should be realized concurrently with the development of the Norman Wells project and were not pre-conditions for that development. It also maintained that the project should encourage the settlement of land claims.

8.3.14 Village of Fort Simpson. In its filed submission, the Village of Fort Simpson, which was not represented at the hearing, conditionally supported the project.

8.4 Views of the Board

8.4.1 Introduction. The Applicant provided the Board with an assessment of the regional socio-economic impacts of the proposed project on the impact area which focused on specific demands which the project would make on the area's people, facilities and resources. In contrast to this, many of the intervenors focused on questions of principle surrounding the project including the negotiation of aboriginal rights,

comprehensive land-use planning in the Mackenzie Valley, northern control over northern resources, and federal-territorial resource revenue sharing.

The Board is cognizant of both the existence and implications of these two different approaches. Because questions of feasibility and desirability are fundamental to an assessment of regional socio-economic impacts, the Board views these two approaches as complementary.

The Board's assessment of these impacts is based on several assumptions. These are:

(1) that the Applicant would implement the policies, programs and commitments made in documents filed with the Board or statements made during the hearing;
(2) that the Applicant would generally follow the spirit of recommendations made by its consultant where IPL (NW) has not specifically endorsed these; and
(3) that Esso Resources would abide by the policy statements on the record and would generally follow the spirit of recommendations made by the consultant in relation to the fieldgate portion of the combined projects.

8.4.2 First Question: Regional Feasibility. By addressing feasibility, the region's capacity for handling project demands can be evaluated, and potential problem areas and possible mitigative measures identified.

It is the Board's view that both the nature of the expected regional socio-economic impacts identified by the Board in its "Northern Pipelines" decision, as well as the reasoning used to arrive at its assessment in that report, can be applied to the IPL (NW) proposal. However, in terms of project demands, the shorter construction period and the reduced scale of the IPL (NW) pipeline render its requirements much smaller than those of its proposed predecessors and thus its potential impacts less severe.

The Board is of the view that while the overall population impact of the proposed project falls within a

manageable range, the communities of Norman Wells and Fort Simpson could be potential problem areas. Norman Wells in particular could be expected to experience a significant population influx throughout the life of the project. This could be compounded during the construction phase because of the presence of a large construction work force in or close to the community. In Fort Simpson, although the absolute size of population increase might be manageable, the Board notes that this community is comprised of a majority of native people and the Board views any project-induced change in the population mix as having the potential for significant adverse social impacts. Further, while the Board does not believe that speculative in-migration would be a significant problem at the regional level, such migration would likely impact more on Fort Simpson because of its accessibility as a transportation center for the entire impact corridor.

With the possible exception of trucking and telephone systems, the Board does not anticipate any undue pressure on transportation and communication systems. It would appear that sufficient excess capacity exists in the marine (barging), rail, and road modes, while air capacity could be quickly expanded to accommodate the combined projects' demands.

Manpower demands on community infrastructure, services, facilities and resources would centre on Yellowknife, Hay River, Fort Simpson, Norman Wells, Zama City and perhaps High Level. Fort Simpson and Norman Wells would likely have the greatest demands placed on their social and economic infrastructure. The Board believes that with proper planning and consultation, major problems in these areas could be avoided.

It is also the Board's view that the combined projects would subject local economies to some inflationary pressures and that these would fall most heavily on people on fixed or less flexible and low incomes.

The Board is also of the opinion that the project would physically impinge upon the traditional and subsistence

activities of Northerners and could cause diversion of manpower away from this sector towards the project. Since this sector is sensitive to inflationary pressures and since the magnitude of losses is difficult to predict and determine, it would appear virtually impossible to mitigate or compensate for all project-induced impacts upon this sector.

The Board agrees with the GNWT regarding its need for additional funding to deal with those socio-economic impacts of the project that are within the legislative purview of the territorial government. The Board also concurs with the assessment of the Applicant's consultant that the provincial and regional governments of northern Alberta are able to handle the demands of the proposed project.

Should the combined projects proceed, in addition to expecting adherence to the commitments made by the Applicant and Esso Resources, the Board wishes to stress the need for continued, and in some cases, intensified, community consultation, liaison and information. The Board views as important the roles to be played by advisory councils and project liaison officers in key impact areas such as the communities of Norman Wells and Fort Simpson. This process would require the co-ordinated planning efforts of the proponents, communities, and the GNWT.

To ensure the priority of regional demands over project demands, to identify project problem areas, and to provide possible solutions, the Board sees the need for an effective monitoring system.

The Board notes that the fieldgate portion to be developed by Esso Resources could account for half the regional impact during construction and for even more during the project's operation. Although the Board has no regulatory control over the management of impacts associated with this portion of the combined projects, the Board anticipates that Esso Resources, to maintain good relations with the communities and the territorial government, would promote local participation, and implement measures to minimize negative impacts where possible.

In general, the Board is of the opinion that the proposed project would not unduly tax the infrastructure, services and facilities of the impact area's communities. It is also the Board's view that the commitments by both the Applicant and Esso Resources to implement the policies and mitigative measures identified would go some way towards reducing problems and costs.

8.4.3 Second Question: Regional Desirability. The Board is of the opinion that the benefits that would accrue from the combined projects to the impact area would be manifest mainly in terms of employment opportunities, business opportunities, and territorial government revenues.

The Board accepts the employment figures provided by the consultant. In general, the Board is also of the opinion that project-generated employment would provide some benefits to the impact area. However, the extent of these employment opportunities or benefits cannot be determined at this time. Further, the Board considers that non-natives, being presently more integrated into the wage economy, and currently possessing more of the skills and training to gain access to and retain these positions, are more likely to benefit from project-related employment than are native people.

In relation to local business participation, as no evidence was provided on the capabilities or likelihood of northern businesses attaining the levels of opportunities estimated by IPL (NW) and its consultant, it is not possible to determine or quantify the benefits associated with northern business involvement in the proposed project.

However, although potential levels of involvement remain indeterminate, the Board believes that some degree of northern business participation would occur. It anticipates that the bulk of these business opportunities would take place during the relatively short construction period. The Board expects that annual project expenditures during the operations phase would not be significant throughout the impact area, but

could represent sizeable business opportunities for Fort Simpson and Norman Wells.

Since the proportion of native-owned businesses in the Northwest Territories part of the impact area is relatively small, the Board is of the opinion that most of the project's business benefits would likely accrue to the non-native segment of the population.

As to the potential increase in revenues accruing to the territorial government, the consultant estimated these to be $2.5 million during construction and $1.9 million per year during operations and maintenance. Although the GNWT's estimates were somewhat lower, the Board observes that these returns are small in comparison to total territorial revenues. Expected impacts on government revenues in Alberta would also not be significant.

It was suggested that these revenues would constitute a step towards economic self-sufficiency for the Northwest Territories. Witnesses from the GNWT did not share this view and believed instead that once costs were taken into account, any positive returns flowing to the territorial government would be slight.

It is a matter of record that previously the views of intervenors given in a previous hearing were divided between a "no development until negotiation of aboriginal rights" position and a "development now" stance. In this hearing, the Board has noted a convergence of the views of some major intervenors. The Dene, the Métis Association, the GNWT and the Dene Tha' Band agreed that certain conditions had to be met before they would seriously consider giving their approval to the IPL (NW) proposal. Without these conditions, the intervenors believed that the project would have adverse social impacts for the region, would negatively affect native peoples' renewable resource harvesting, and would ultimately result in a loss of control by Northerners over developments which shape their lives.

The Board is aware that the native people in the Northwest Territories portion of the impact area feel that the

negotiation of aboriginal rights would be prejudiced if the project were to proceed under present conditions. The Board agrees with the Applicant that if the issues of land claims and aboriginal rights were settled, the proposed project would be more beneficial from the region's perspective. In the absence of a land claims settlement, the native people viewed themselves as ill-equipped to deal with the demands and impacts of the project. This was compounded by the fact that they subscribed to the corridor concept which considers the proposed project as the first step towards further developments in the Mackenzie Valley. Similarly, in order to mitigate against this type of development occurring on an ad hoc basis, the GNWT suggested the prior development of a comprehensive land-use plan for the Mackenzie Valley.

It is the Board's assessment that under present circumstances any gains resulting from all phases of the proposed project would be small. During the construction period the existing business community in the impact area stands to benefit most from the project.

The Board believes that such benefits as would accrue to the native people of the impact areas would likely result from additional employment as well as some business opportunities generated by the proposed project. However, because of their limited access to skilled positions as compared to non-natives, and because of their present opposition to the project, the benefits to the native population in the Northwest Territories and Alberta would be of relatively minor proportions. As a corollary, they are also most likely, and least able, to bear the greater burden of the costs, whether they be social, economic, cultural or political, associated with the project.

The Dene Tha' Band's position is similar to that of the Dene in the Northwest Territories with the exception that should sufficient employment and business opportunities be made available to them, they believed that the benefits of the project could outweigh its costs.

In summary, it is the Board's assessment that the project holds the potential for generating some benefits in the impact area. However, these benefits cannot be quantified at this time. As to the negative impacts, also unquantifiable at this time, the Board notes that some of these costs, by their nature, cannot be fully ameliorated through compensation or mitigation. Moreover, the Board is of the opinion that irrespective of the actual level of negative impacts, the distribution of those would fall most heavily on the native people of the impact area who are least equipped to participate in the positive impacts of the project.

During the hearing, the Applicant's consultant indicated that local views regarding the project were not apparent prior to the filing of the application and thus were not incorporated into their study. Given that the majority of the impact corridor's population is of native origin, and that their views were not incorporated, the Board finds it difficult to agree with the Applicant that the regional benefits of the project, as proposed, would outweigh the negative effects.

8.4.4 Conclusions and Recommendations. It is the Board's view that, provided certain measures are taken, the proposed project is feasible and could be built without unduly taxing the infrastructure, services, facilities and resources of the impact area. In terms of regional socio-economic desirability, the Board is of the opinion that the project would not necessarily provide the region with a net positive benefit, but rather that its modest potential benefits and potential liabilities would balance out.

Should a certificate be granted, the Board would require that the following conditions be met:

(1) that the Applicant prepare and develop, prior to construction, the key elements of each of the socio-economic plans and programs which the Applicant undertook to carry out. These would include those dealing with information-consultation-liaison, cultural and traditional

resource harvesting, opportunities for Northerners and northern businesses, effects on communities, regional effects, compensation and monitoring. These would have to respond to the Board's concerns as noted in preceeding pages.

Given the importance of these plans and programs to the impact area, the Board believes it necessary that these be subject to public scrutiny and approved by the Board prior to implementation. In addition, given the importance of the fieldgate facilities on the regional socio-economic impact assessment of the project, the Board suggests that the Applicant make every effort to secure Esso Resources' cooperation in the preparation of these plans and programs.

(2) that the Applicant report to the Board, within six months following the first twelve months of pipeline operation, on the actual socio-economic impact of the combined projects during the construction period and the first year of operation.

Apart from the above conditions that would be imposed pursuant to the National Energy Board Act, the Board suggests that the Applicant, the GNWT, and the appropriate federal government agencies, prepare and implement a plan for monitoring socio-economic impacts at the regional level during construction. Such a plan should have the capability of seeing that corrective measures were taken as required. In the Board's view the monitoring system should, once in operation, be independent of the Applicant.

While the views of the Board on regional socio-economic impact included that part of the impact area which lies in northern Alberta, certain circumstances within the area make it unique. It is thus important that the Applicant's plans and programs adequately reflect the following matters as well as those already discussed.

Although sympathetic to the Dene views, the attitude and views of the Dene Tha' Band differed from the views of

native people in the Northwest Territories part of the impact area. One of the major conditions for the Band's support of the project was that it be provided with the possibility of meaningful participation. The Board would require that the Applicant update its socio-economic data base on the Dene Tha' Band and on other Bands in the area that could potentially participate in the project. While the Board recognizes that the Applicant's consultant prepared their impact assessment primarily on the basis of an existing literature review, its applicability to the Dene Tha' Band is in some doubt. In recent years in the Northwest Territories part of the impact area, various studies, inquiries and hearings have permitted pertinent and relatively up-to-date information to surface. This is not the case for the Alberta portion of the impact area.

Given the importance of accurate information as a basis for the preparation of the Applicant's plans, should a certificate be issued, the Board would require that prior to or concurrent with the preparation of other plans and programs for the project, the Applicant update and file with the Board its socio-economic impact assessment of the northern Alberta part of the impact area ensuring that every effort would be made to involve the residents of the area.

In addition, the Board recognizes the concerns of the Dene Tha' Band with respect to the Applicant's compensation plans and procedures. The Board would expect that the compensation plans to be developed by the Applicant in accordance with the foregoing condition (1) would address, as fully as possible, the Band's concerns as expressed at the hearing.

CHAPTER 9
LAND CLAIMS

9.1 Introduction

Mr. Justice Thomas R. Berger, in his report of April 1977, summarized the philosophy of native land claims in the following passages:

> Their claims must be seen as the means to the establishment of a social contract based on a clear understanding that they are distinct peoples in history. They insist upon the right to determine their own future, to ensure their place, but not assimilation, in Canadian life....
>
> Their concerns begin with the land, but are not limited to it: they extend to renewable and non renewable resources, education, health and social services, public and overarching all of these considerations, the future shape, order and the composition of political institutions in the North.(1)

Against this background, the settlement of claims can be expected to involve far more than just the signing of agreements. Mr. Justice Berger predicted that it might take a generation or more to define and redefine the relationship with the native people and their place in Confederation.

Mr. Justice Berger opened the Mackenzie Valley Pipeline Inquiry in March 1975. The project was to be a unique examination of the terms and conditions to be imposed on the construction of any pipeline. In evaluating these terms, Mr. Justice Berger was to consider the social, environmental and economic impact of a gas pipeline and that of an energy corridor across the northern territories. To the native people, the Berger Inquiry was the first attempt to listen to their needs and desires at a grass roots level.

Through discussions with the Indian people, Mr. Justice Berger discovered that the problem at hand was not simply a debate about a gas pipeline and an energy corridor, but rather

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(1) The Report of the Mackenzie Valley Pipeline Inquiry (April 1977) Vol. One, Chap. 11, p. 163

a debate about the future of the North and its people. The overwhelming response of the native communities to the inquiry was that "no right-of-way be granted to build a pipeline until native claims along the route, both in the Yukon and Northwest Territories, have been settled."(2) The paramount question then was not if or how to build a pipeline but whether the native people would be able to participate in determining what the future of the North should be. The pipeline was viewed by the Dene as an important and powerful bargaining point for achieving their principal goal of self-determination. Their fears of how large-scale resource development might affect the social, economic and environmental structures in the North are strong. The question of impingement on aboriginal rights is of paramount concern to the resident populations of the North.

9.2 Evidence of the Applicant

IPL (NW) stated that it had no official position on native land claims as this is a matter to be resolved between the federal government and the native people. With respect to the Berger Inquiry and its recommended 10-year moratorium, the Applicant viewed Mr. Justice Berger's recommendation as applying only to the construction of a large-diameter gas pipeline as proposed by Canadian Arctic Gas Pipeline Limited and Foothills Pipe Lines Limited. Approval of that project would have entailed a commitment by the Canadian and Northwest Territories' governments to a program of large-scale frontier development which could not have been avoided. The Applicant voiced its understanding that Mr. Justice Berger's recommendations were not adopted as official government policy. However, the Applicant realized that they could not be ignored. In the Applicant's view times have changed; current national considerations and the proposed project size make this an entirely different project from that considered by Mr. Justice Berger.

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(2) Ibid.

In the Applicant's view, the present proposal is for a small-diameter oil pipeline. It involves no commitment to large-scale development in the Mackenzie Valley, being simply a facility for the transportation of crude oil produced from a single crude oil field. The proposed pipeline would not traverse the Mackenzie Delta but would run south from the Norman Wells field located in the Valley itself. The Applicant stated that the pipeline could be constructed using existing technology previously employed in the construction of small-diameter pipelines in northern Alberta. These differences mean that physical disturbances, size of the construction crew and equipment used, could have far less impact on the land and on the socio-economic considerations involved.

Further, the Applicant contended that the construction and operation of a small-diameter pipeline would provide a healthy stimulus contributing to an orderly development of the infrastructure and would provide experience applicable to managing and controlling possible future large-diameter pipeline construction through this area. The Applicant believed that stimulus to local employment and business should be positive and would not have major disruptive impacts on northern residents. The implications of insecurity of crude oil supply and the current economic costs to the nation of importing foreign oil are far more serious considerations today than they were at the time of the Berger Inquiry; the project must be considered in the light of these changed circumstances.

The Applicant also stated that it saw no reason why the project could not proceed while native land claims negotiations were still in progress.

The Applicant was of the opinion that this pipeline project had served as a catalyst to advance negotiations on aboriginal rights and the development of self-determination for the Northwest Territories since little progress had been made until the filing of the proposed project.

The Applicant testified that the land required for the pipeline right-of-way and ancillary facilities, although selected prior to the settlement of land claims, would not necessarily be excluded from any later selection of land for use by native people.

The Applicant did not deny the importance of aboriginal rights and regional self-determination and shared the hope of most Canadians that these matters would be resolved fairly and expeditiously. Moreover, the Applicant stated that it would abide by the results of the settlement as finally determined.

9.3 Views of Intervenors

9.3.1 Canadian Arctic Resources Committee. CARC stated that it did not oppose the principle of the pipeline's construction per se, providing certain conditions were met. CARC believed that the pipeline would be in the interest of all Canadians, including Northerners. One of the conditions stipulated would be the settlement of native land claims. CARC supported the Dene Nation's opposition to this project as it would, at a minimum, prejudice land claims negotiations, if not set them back for years.

CARC felt that DINA, responsible for advancing native interests, could not be expected to negotiate a fair claims settlement, as it stood to be one of the main beneficiaries of the Norman Wells expansion as a result of DINA's one-third interest in the field.

CARC further stated that it should be recognized that there are demands on the strip of land along each side of the Mackenzie River, other than as a transportation corridor. Native uses must be recognized; many Indian organizations would want to claim land along the river within their land claim settlement.

CARC agreed that it was not up to the Applicant or the Board to deal with the native land claims question and its eventual resolution.

CARC recommended that the Board rule, as it did three years ago in its "Northern Pipelines" decision, that until there is a settlement of the Dene claim, it is not in the public interest to proceed with the Norman Wells pipeline.

9.3.2 City of Yellowknife. The City of Yellowknife stated that its council had decided not to adopt a position on Dene or Metis land claims. It indicated, however, that it agreed with the concept that a just, fair, equitable and quick settlement of aboriginal rights was necessary.

9.3.3 Committee for Justice and Liberty Foundation. CJL stated that the proposed pipeline from Norman Wells to Zama threatened to prejudice and weaken the native land claim negotiations position of the Dene and Metis by eroding their aboriginal and human rights. In final argument, CJL stated that the evidence of the Dene Nation clearly established that the Dene claim would be prejudiced in the following ways:

> The Dene are denied the political rights to decide whether a pipeline should be built on their land, that is, to have their political institutions in place before a pipeline decision is made.
>
> The Dene are denied the right to negotiate with the companies to increase economic benefit and decrease social costs for the Dene from a pipeline should it be built and in general the right to regulate the companies, that is, to have their economic and regulatory institutions in place before the pipeline is built.
>
> The Dene are denied the right to have a strengthened Dene economy in place in their communities in the renewable resource sector prior to any further major projects in the non-renewable resource sector; this right was cogently supported by Justice Berger.
>
> Building a pipeline prior to a settlement of claims will increase the non-Dene population in the Mackenzie Valley thereby eroding the ability of the Dene to get a just settlement of their claims.
>
> Insofar as any settlement is likely to involve a categorization of land, or a land selection process, the further alienation of land that inheres in the pipeline

> project, both directly and indirectly by encouraging further exploration or by increasing the probability of a Mackenzie Corridor, constrains the choices left to the Dene and thereby prejudices their claim.
>
> The ad hoc process of evaluation of specific projects like this pipeline runs counter to any overall process of economic planning for the Mackenzie Valley which the Dene might wish to introduce; the approval and building of this pipeline with the disorder it would create would decrease the prospects for orderly planning in the future and prejudice the effectiveness of a future settlement.(3)

CJL further submitted that the opportunity to work out a land claims settlement would be thoroughly undermined if a pipeline were allowed to proceed before a settlement with the people through whose historic homeland this pipeline would pass. CJL stated that a settlement which was to confer on the Dene people the right to influence what takes place on their land would hardly be a meaningful document should a project such as the Norman Wells oil field expansion and pipeline be initiated on their land without the concurrence of the Dene and the Metis.

It also stated that for the federal government to by-pass normal legal processes and permit a pipeline to proceed through land the ownership of which is a matter of serious legal dispute, is to set an example of lawlessness by its own behaviour which would serve as an unfortunate model for those whom it must persuade to use lawful means to secure their ends.

9.3.4 The Dene Nation and the Metis Assocation. The position of the Dene Nation and the Metis Association remains unchanged from that expressed by Mr. Justice Berger in The Report of the Mackenzie Valley Pipeline Inquiry: "In my judgement, we must settle native claims before we build a Mackenzie Valley pipeline."(4)

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(3) Ibid
(4) Ibid p. 192

The Dene and Metis asserted that to certificate this project, in advance of the settlement of native land claims being settled, would prejudice their claims. In addition to the six enunciations of prejudice mentioned by CJL, the Dene and Metis indicated that the Mackenzie Valley pipeline hearings had diverted their attention from the settlement of their aboriginal claims and placed the Dene Nation and the Metis Association in an adversarial position in relation to other northern residents and later between themselves.

The Dene and Metis submitted that approval of the present project would not further advance the claim settlement process despite the Applicant's suggestion that it would. Rather, it would likely have a disruptive effect and again place the native people, the Dene and Metis, in adversarial positions vis a vis the government and industry. They believed that it would destroy what faith there is in the integrity of the government and its processes.

The Dene Nation and the Metis Association mentioned in evidence that they supported the orderly development of northern non-renewable resources, which would bring real and lasting benefits to the people of the Northwest Territories. To say that they were not interested in development at all would be incorrect. However, before any large-scale development proceeded, a just and equitable aboriginal rights settlement would have to be in place.

9.3.5 Government of the Northwest Territories. The GNWT supported the Norman Wells field expansion and the construction of a pipeline to carry the increased production to existing markets, but with conditions.

One of these conditions would be that meaningful progress should first be made on the negotiation of aboriginal claims. The GNWT believed that to proceed with this project without sufficient progress in the negotiations of aboriginal rights could once again produce the kind of social, cultural, economic and political upheavals which were prevalent in the

North in the mid-seventies. The GNWT was not proposing that rights negotiations be completed, that settlement acts be passed in national and territorial legislatures, or that their implementation be completed before this or any other project proceeded. Rather, it advocated a compromise position urging all parties concerned to proceed with negotiations to a point where native people felt that their rights would be protected.

The GNWT emphasized that its policy on native land claims was developed in concert with the leadership of the Metis Association and the Dene Nation who, together, represent at least half of the population of the western Northwest Territories.

9.3.6 Hay River and Area Economic Development Corporation. The Hay River and Area Economic Development Corporation stated that the question of aboriginal rights and native land claims were matters to be negotiated simultaneously with orderly development in the Northwest Territories. It argued that this would be required to ensure that the North not be further depressed economically through lengthy negotiations for just and reasonable settlements.

9.3.7 Inuvik and District Chamber of Commerce. The Inuvik and District Chamber of Commerce stated that the proposed pipeline project would assist in the settlement of native land claims in the Mackenzie Valley in the same way other resource projects did in James Bay, other areas of Quebec, and Alaska. In those areas, the actual settlement of native land claims was given impetus by impending industrial development. The Inuvik and District Chamber of Commerce was of the opinion that the Norman Wells project could open the door for claims action on a "settlement with development" or "development with settlement" basis. As an example, it cited the COPE claims agreement in principle, covering the western Arctic, under which native land claim negotiations and ongoing petroleum resource activities and other resource development in the Mackenzie Delta and

Beaufort Sea areas were being carried out simultaneously with mutual support.

It gave further evidence that the Minister of DINA had stated that industrial developments in the North could not be held up by land claims discussions and that no development would be allowed to adversely affect a land claim. The Inuvik and District Chamber of Commerce also mentioned that not being ready for development could no longer be accepted as an excuse for claims inaction when little is being done to get ready for negotiations.

9.3.8 Town of Inuvik. The Town of Inuvik agreed with the Inuvik and District Chamber of Commerce in its support of the immediate development of the Norman Wells oil field expansion and pipeline project and believed that the project should provide a forward thrust in land claim negotiations or settlements or both.

9.4 Views of the Board

Although the federal government may be currently considering treaty rights, ownership, territorial jurisdiction, and other related questions, these are not matters with which the Board is involved.

The Board recognizes the importance of native land claims. However, on the basis of the evidence before it, the Board is not convinced that approval of the proposed pipeline project would in fact prejudice the settlement of native claims.

CHAPTER 10
CORRIDOR CONCEPT

10.1 Introduction

One of the major concerns expressed at the hearing was that the pipeline proposed by the Applicant would only be the first of a series of developments in the Mackenzie Valley corridor, that is, "the thin edge of the wedge." It was felt that the influence of the first trunk pipeline would shape a transportation corridor system and provide direction to the environmental and social future of the region. In cross-examination, CARC introduced the "Expanded Guidelines for Northern Pipelines." IPL (NW) was later requested to state whether these guidelines had been taken into consideration in the preparation of its application to the Board.

10.2 Expanded Guidelines for Northern Pipelines (1972 Pipeline Guidelines)

The 1972 Pipeline Guidelines were intended to reflect the government's views, at that time, on the construction and operation of oil and gas pipelines in the Yukon and Northwest Territories. The proposed guidelines dealt with, inter alia, the corridor concept and its environmental and social implications. These provided for the establishment of a "corridor" to enclose trunk oil and gas pipelines as well as other utilities.

Control of pipeline routes was required to minimize environmental and social disturbance, to ensure maximum benefits to northern residents and communities, and to channel resource development in accordance with government priorities. In developing the concept of a pipeline "corridor," the government of Canada recognized the need for flexibility in the choice of pipeline routing to allow for resource and market locations, economic considerations, engineering and construction requirements, as well as the severity and sensitivity of Arctic terrain conditions.

The concept of "one trunk oil pipeline and one trunk gas pipeline" within a "corridor" was enunciated with the intention of confining any environmental and social disturbance resulting from trunk pipelines to a narrow zone. It was also recognized that restriction of both oil and gas pipeline construction activities to a narrow "corridor" would lead to increased concentration of land use and the possibility of unacceptable environmental and social disruptions. The routing of oil and gas pipelines close to other transportation-communication systems, and the probability of the subsequent development of such systems adjacent to pipelines, could have added to the problems of maintaining the environment. Even minor disturbances arising from adjacent development activities might have reinforced one another, to produce cumulative ecological disruptions. Moreover, local shortages of gravel or other granular materials could have resulted from close spacing of construction projects. In addition, under some circumstances, the differing terrain requirements of oil and gas pipelines might have prevented adjacent routings. Thus, caution would have had to have been exercised in the selection of specific routes or "corridor" boundaries.

These guidelines were not intended to be construed as replacements for the requirements of applicable acts, orders or regulations.

10.3 Evidence of the Applicant

The Applicant testified that the proposed pipeline route had been selected on the basis of the requirements for this particular pipeline and that the possibility of any future pipeline was not a criterion in route selection.

The Applicant further testified that it was familiar with the 1972 Pipeline Guidelines but it understood that these had been issued to indicate the general scope of the elements

that should be considered in designing a pipeline to be constructed in northern climates. At the time that these were developed two or more large-diameter pipelines were being considered simultaneously. Proposed were two major gas and oil trunk lines coming down from the Delta and along the Mackenzie River. The Applicant also indicated that during the early seventies there were no regulations or guidelines as to how such major trunk pipelines should be designed and constructed.

Under cross-examination the Applicant stressed that, unlike earlier proposals for major trunk gas and oil pipelines, its proposal was for a single 323.9 mm diameter line of pipe. However, the Applicant did agree that a future oil pipeline from the Beaufort Sea, along the Mackenzie Valley, could be a possibility.

The Applicant noted that the route selected for the Norman Wells line would not necessarily govern the location of any future pipeline should one be considered, and stated that the impact of each project would have to be judged on its own merits.

The Applicant also stated that, in the preparation of its application, it had complied with the Board's Oil Pipeline Regulations and environmental rquirements contained in Part VI of the Schedule to the Rules of Practice and Procedure, presently in force.

The Applicant also submitted in evidence a letter from DINA setting out regulations to be followed in making an application for the construction of the proposed Norman Wells to Zama pipeline. The Applicant stated that the 1972 Pipeline Guidelines were not included in the lengthy list of regulations set out by DINA.

Nevertheless, the Applicant submitted that generally it had met the requirements of the 1972 Pipeline Guidelines although it did not look upon the guidelines as a current expression of government policy.

10.4 Evidence of Intervenors

10.4.1 Canadian Arctic Resources Committee. CARC stated that the 1972 Pipeline Guidelines must be adhered to not only for regulatory reasons but because they provided a good basis for planning the use of renewable and non-renewable resources in the region.

CARC recommended that the Board delay the issuance of a certificate to IPL (NW) until the company had complied with the 1972 Pipeline Guidelines. It recommended that the Board request the Applicant to assess the suitability of its proposed route for the nearby routing of other pipelines, in terms of the environmental, social, and terrain engineering consequences. The assessment should include an analysis of the cumulative environmental and social impacts of building several pipelines in the same corridor.

CARC further stated that the proposed Norman Wells pipeline must be seen as the first step in the creation of an energy corridor in the Mackenzie Valley. At the very minimum, the Norman Wells pipeline would establish a right-of-way for future pipelines. For this reason CARC suggested that the proposed pipeline must be located taking into account the possibility of a future parallel oil pipeline.

CARC's view was that the proposed pipeline's existence would stimulate oil exploration in the Mackenzie Valley since its existence would be taken into consideration in any oil transportation project originating in the Mackenzie Delta or Beaufort Sea areas.

In final argument, CARC stated that during the course of the hearing the following had become evident:

(1) more pipelines would be built in the Mackenzie Valley;
(2) the 1972 Pipeline Guidelines have not been "repealed";
(3) those guidelines require the assessment of cumulative environmental effects;

(4) cumulative environmental effects have not been assessed although the information to do so is available; and

(5) without coordination through land use planning, each new initiative will compete for space and local resources.

CARC agreed that although the Board had promulgated a number of regulations since the 1972 Pipeline Guidelines were issued, these in many cases cover similar ground but do not specifically address the establishment of an energy corridor in the Mackenzie Valley, nor the cumulative and synergistic environmental and social effects which might ensue. It concluded, therefore, that the Applicant still had the responsibility to meet the 1972 Pipeline Guidelines.

Under cross-examination, CARC stated that the 1972 Pipeline Guidelines were just that, guidelines, and were never made regulations. CARC also agreed that the 1972 Guidelines invited public comment, which implied that further changes might be made. CARC was also aware that the Applicant had not been requested by the Board to comply with the requirements of the 1972 Pipeline Guidelines.

10.4.2 Committee for Justice and Liberty Foundation. CJL was of the opinion that the concluding judgements of the Board in its "Reasons for Decision, Northern Pipelines, 1977" and the conclusions of the Berger Commission, both of which were based upon substantial social, economic, and environmental impact studies, were applicable to the proposed Norman Wells pipeline. One of the premises upon which this contention rested was that the proposed oil pipeline must be viewed as part of a plan for the establishment of an energy corridor along the Mackenzie Valley.

In its final argument, CJL indicated that in its application before the federal environmental assessment and review panel, the Applicant had stated that the proposed

pipeline would provide a primary transportation route for subsequent oil and gas development, as well as the first-in-place development for a resource corridor in the Mackenzie Valley.

CJL believed that the studies and judgements of the Berger Commission and the Board in 1977 were not based on the construction of a single pipeline only. Rather, the primary concern was with the establishment of what Justice Berger called the "corridor concept," whereby the construction of one pipeline would open up a transportation and energy corridor through the Mackenzie Valley.

It was CJL's contention that the federal government's Pipeline Guidelines of 1970 and 1972 provided an outline for this concept. Together, these constituted what the Berger Commission called "the cornerstone of Canadian policy with regard to the construction of northern pipelines." The underlying assumption was that an oil pipeline would be constructed first followed by a gas pipeline in the Mackenzie Valley or vice versa. The guidelines envisaged, in addition to pipelines, a whole transportation corridor with roads, a railroad, hydro electric transmission lines, and telecommunication facilities. CJL believed that the cumulative impact of all the above facilities on the social, economic, and environmental future of the North would be enormous.

Thus, CJL argued that, regardless of its size, the proposed Norman Wells oil pipeline would likely serve as a triggering mechanism for the construction of a major energy and transportation corridor through the Mackenzie Valley. It further argued that the construction of the proposed oil pipeline would likely be followed by the construction of a gas pipeline and related transportation facilities. This, in CJL's view, was the reason why the 1972 Pipeline Guidelines called for an examination of the social, economic and

environmental consequences of an energy corridor rather than of any single pipeline project. As the Berger Commission noted, any attempt to break down the policy and to assess the impacts in a piecemeal fashion, should be resisted.

10.4.3 Dene Nation and the Metis Association. The Dene Nation and the Metis Association adopted CARC's statements on the corridor concept as enunciated in the 1972 Pipeline Guidelines.

The Dene Nation and the Metis Association indicated that these statements had been tabled in the House of Commons and therefore were an expression of government policy. They suggested that, although Board regulations now exist, the 1972 Pipeline Guidelines have never been repudiated and constituted a rational and prudent tool for the evaluation of the impact resulting from the construction of a northern pipeline.

In conclusion, the Dene Nation and the Metis Association stated that the Board, in conducting its assessment of this application, should review and apply the 1972 Pipeline Guidelines, the corridor concept which is integral to them, and the cumulative impact of several pipelines built and operating in the Mackenzie Valley.

10.4.4 Government of the Northwest Territories. The GNWT supported the expansion of the Norman Wells field and the construction of a pipeline to carry the increased production to existing markets, under five conditions.

One condition would be the establishment of a joint territorial/federal authority to prepare a non-renewable resource development plan for the Mackenzie Valley and Delta, as well as for the Beaufort Sea region.

The GNWT did not agree with the Applicant's position that the Mackenzie Highway Development Area adjacent to the Mackenzie Valley and along the planned route of the highway is, or was intended to be, a transportation corridor. Rather, it believed that it was established to allow the territorial

government to regulate secondary development associated with the highway and was not part of a land planning process.

The GNWT stated that by reacting to such proposals as the proposed Norman Wells to Zama pipeline, the federal government was deferring or abdicating its responsibility for comprehensive planning. Its opinion was that future pipelines or other linear developments were likely to follow the route of the first project. The territorial government considered that, if there were to be a transportation or energy corridor in the Mackenzie Valley, the best route should be selected prior to the building of the first pipeline and that the best route might not parallel the Mackenzie Highway route.

In conclusion, the GNWT sought the postponement of a federal decision to approve this project until its five conditions had been adequately addressed by the federal government and the people of the Northwest Territories.

10.5 Views of the Board

The Board acknowledges the intended purpose of the 1972 Pipeline Guidelines, as they pertain to trunk oil and gas pipelines within a "corridor." For the purpose of the exercise of its jurisdiction over the project for which certification is sought, the Board does not consider these guidelines to be binding on the Applicant. The Board notes that the Applicant's adoption of certain of the guidelines is useful to the project.

The Board is satisfied that evidence presented by the Applicant to meet the requirements of the National Energy Board Act, the Board's Oil Pipeline Regulations, the environmental provisions contained in Part VI of the Schedule to the Board's Rules of Practice and Procedure, and the provisions of the Board's Socio-Economic Guidelines, provide the appropriate basis upon which to assess the Applicant's proposal for the construction of the subject oil pipeline.

CHAPTER 11
COST-BENEFIT ANALYSIS

11.1 Evidence of the Applicant

The cost-benefit study submitted by IPL (NW) assessed the net economic benefits to Canada of developing the Norman Wells oil reserves and marketing the product in eastern Canada by assessing the direct costs and benefits associated with the production facilities and those associated with the proposed project.

IPL (NW) evaluated the proposed project over the period 1980 to 2008. In calculating the direct benefits, IPL (NW) took into account revenues from the sale of crude oil and NGL together with the potential saving in oil import compensation payments resulting from the displacement of imported crude oil by similar volumes produced from Norman Wells.

Revenues from the sale of crude oil and NGL were based on prices in Montreal, netted back to Zama Lake by deducting the average tariff from Montreal to Edmonton and then deducting fractionation costs and the average tariff of Rainbow Pipe Line. The benefits from the savings in oil import compensation payments were calculated by multiplying the oil import compensation rate by the project's oil and NGL volumes, excluding ethane. The NGL volumes were converted to an equivalent amount of crude oil on the basis of heat content.

In determining total costs, IPL (NW) included the costs of production facilities, pipeline construction costs and operating costs over the life of the proposed project.

Alternatively, IPL (NW) considered not proceeding with the project at this time. This meant using the oil from Norman Wells at a time so far in the future that it would have a negligible present value.

On the above premises, the Applicant estimated that the net economic benefits to Canada of the proposed project would be $1.4 billion (present value to 1980 in 1979 dollars

based on a ten percent rate of discount). Sensitivity analysis on the rate of discount indicated that the net economic benefits would rise to $2.9 billion based on a five percent real rate of discount and drop to $719 million based on a fifteen percent real rate of discount.

The Applicant noted that all the benefits and costs of a project cannot easily be quantified; therefore, the quantified net economic benefits plus non-quantified beneficial effects must be weighed against the non-quantified negative effects. Among the benefits not quantified in the analysis were security of supply, employment of otherwise unemployed resources and the effect on balance of payments.

The Applicant argued that, in the absence of the proposed project, a disruption of oil supply would result in a greater loss of consumer surplus than would otherwise be the case. It also argued that given the current level of unemployment in Canada, the IPL (NW) project might be able to employ previously unproductive workers in the economy, thus decreasing the opportunity cost of labour and increasing the net economic benefits of the project.

In relation to the Canadian balance of payments, the Applicant stated that the reduction in oil imports resulting from the project would reduce Canada's foreign exchange requirements. This saving would allow some appreciation of the Canadian dollar or would be available for other uses.

The environmental and regional socio-economic impacts were listed as unquantified social costs against which the net economic benefits of the projects must be weighed.

11.2 Evidence of Intervenors

CJL, in its final argument, stated that the cost-benefit analysis as a whole suffered limitations and that the Applicant's study in particular was "deeply flawed." The inability of analysts to quantify all costs and benefits, and the fact that cost-benefit analysis did not look at the regional or distribution effects of the project were given as examples of the limitation of cost-benefit analysis.

In relation to the IPL (NW) study, CJL argued that using a discount rate to arrive at net economic benefits is not equivalent to looking at alternative uses of capital. Thus, alternative uses of capital should have been explicitly considered. Investment in conservation measures was given as an alternative to the proposed project which in CJL's view would cost less, produce more permanent jobs and relieve our balance of payment problems.

11.3 Views of the Board

In the Board's view, revenue from the sale of oil and NGL at Zama Lake would be more accurately represented by deducting incremental rather than average tariffs to eastern Canada to arrive at the net back prices at Zama Lake.

The saving in oil import compensation payments estimated by IPL (NW) were based on crude oil and NGL volumes. In the Board's view, only the savings from crude oil volumes should be considered since Canada does not import substantial quantities of NGL.

Because of the small volumes that would be generated from this project, the Board does not consider the benefits from increased security of energy supply to be significant.

The Board also considers insignificant the increased net benefits derived by using opportunity cost of labour rather than the actual cost of labour.

The Board agrees with the Applicant that benefits from the effect of this project on the balance of payments are difficult to quantify.

Regarding the criticism of cost-benefit analysis as a whole by CJL, the Board recognizes that such studies provide one perspective (a national one) and do not deal with the distributional aspects of the project. Nevertheless cost-benefit analyses are important as an assessment tool and the Board notes that regional socio-economic and environmental studies were undertaken by the Applicant to provide other perspectives.

TABLE 11.2.3

Board's Estimates of Net Benefits to Canada resulting from IPL (NW)'s project

(Present value in billions of 1979 dollars)

	Discount Rate		
	5 Percent	10 Percent	15 Percent
Base Case*	$2.54	$1.31	$ .71
Changes to the Base Case			
Capital & Operating Costs			
+10%	2.47	1.26	.67
+25%	2.37	1.18	.60
Production Volumes			
-10%	2.22	1.13	.60
-25%	1.73	.86	.43
Crude Oil Price			
+5% per annum	5.85	2.85	1.52

* Base case corresponds to the capital expenditure and production volumes in the application.

In the Board's view, it is neither necessary nor possible for cost-benefit analysis to consider all possible alternative uses of capital explicitly. Discounting the net economic benefits accomplishes this. The range of discount rates can be used to cover differing opinions of the opportunity cost of capital.

As part of the Board's assessment of the evidence, it made its own cost-benefit analysis of IPL (NW)'s proposed pipeline project. The Board compared the benefits and costs of the proposed project with the alternative of not proceeding with the project.

In estimating the net benefits, the Board considered the value of crude oil from Norman Wells to be the value of imported crude displaced by the project and the revenue from NGL sales domestically. The principal costs considered were construction costs of the proposed pipeline and production facilities, costs incurred to modify downstream pipelines, and the operating costs for the pipeline and production facilities.

On the basis of the above, the net economic benefits of IPL (NW)'s proposed pipeline project are $1.3 billion (net present value at a ten percent discount rate in 1979 dollars). The sensitivity analysis carried out by the Board on discount rates, oil price, volume and costs indicated positive net economic benefits in all cases as may be seen from Table 11.2.3.

CHAPTER 12
TARIFF MATTERS

12.1 Introduction

The Applicant applied pursuant to Part IV of the Act for approval of the form and content of a "full cost of service" tariff and of the proposed rules and regulations governing the transportation of petroleum as set out in Schedules A and B to the "Norman Wells Pipe Line Agreement." The Applicant stated that the Board's decision on the application under Part IV of the Act was important since the form and content of the tariff, including the rate of return on equity that would apply over the life of the project, are cornerstones of the "Norman Wells Pipeline Agreement," and are fundamental to IPL (NW)'s willingness to construct the pipeline.

The integral parts of the agreement are the full cost of service tariff, which provides the credit support necessary to finance the pipeline, and the rules and regulations governing the transportation of petroleum.

The tariff issues raised through cross-examination at the hearing covered the following aspects of the agreement:

(1) return on equity;
(2) determination of shipper's allocable share of IPL (NW)'s actual full cost of service;
(3) operating expense budget;
(4) allocation of common costs between IPL and IPL (NW);
(5) rules and regulations governing the transportation of petroleum;
(6) extended outage.

12.2 Return on Equity

12.2.1 Evidence of the Applicant. The Applicant proposed a method of regulation representing a departure from the Board's traditional "return on rate base" method of regulation. IPL (NW) proposed that it earn a 16 percent constant dollar return on an equity amount defined in the "Norman Wells Pipeline Agreement."

This definition is as follows:

> 'Equity' means the sum of:
>
> (a) that portion of the cost of the pipeline system which shall be financed by common stock as provided for in Article 7 herein and properly recorded in Account 90;
>
> (b) the amounts relating to the pipeline system properly recorded in Account 91; and
>
> (c) the amounts properly recorded in Account 92 arising from:
>
> (i) earnings retained for financing minor capital additions;
>
> (ii) interest on the equity funds used during construction of the pipeline system; and
>
> (iii) the difference between the full cost of service and the amount actually paid to IPL (NW) by shippers during the 'first operating year.'

The Applicant was questioned on the fact that, with the exception of the item referring to minor capital additions, the dollar value of equity as defined and its return would not change from the second year of the tariff onward. This appeared to lead to a situation where items would be included at full value in the equity base upon which return would be calculated despite the fact that they would have been recovered through depreciation and amortization in the cost of service. In response to this, the Applicant stated that it was contemplated that annual dividends would be equal to earnings and therefore the shareholders would not be receiving those amounts recovered through depreciation and amortization.

Concerning the return on equity, the Applicant stated in evidence that the "Norman Wells Pipeline Agreement," including the return component, was an integral part of the financing plan for the project. The Applicant also indicated that it had considered a rate base form of regulation, but concluded that such a method would increase the return required by equity investors.

12.2.2 Views of the Board. Although there was little evidence to support a departure from a return on rate base form of regulation, the Board does not find the Applicant's approach unreasonable. The Board recognizes that at present only one shipper, a party to the agreement, would be affected by the tariff.

With respect to the definition of equity, the Board is unable to conclude that the failure to adjust the amount in equity as defined would not lead to earning a return on amounts which would already have been recovered through the cost of service. Therefore, it would require that paragraph (c) of the definition of equity in the "Norman Wells Pipeline Agreement" be amended by inserting the words "the unamortized balance of" at the beginning of each of items (ii) and (iii).

The Board notes that a portion of the original equity investment as per paragraph (a) in the definition of equity is also recovered through depreciation. However, considering the magnitude of the recovery and the fact that the "Norman Wells Pipeline Agreement" was negotiated at arm's length between the shipper and the builder of the line, the Board holds the view that only the aforementioned change need be made to the definition of equity.

The Board accepts the method of regulation and the tariff, including the 16 percent return on equity, proposed in the agreement with the previously stated changes in the definition of equity. However, the Board, in arriving at just and reasonable tolls, must be concerned that the tariff will be fair to all parties rather than just the single prospective shipper and the project sponsor. Therefore in indicating its acceptance of the method of regulation the Board notes that the method may be reviewed at any time that it becomes evident that other shippers intend to use the pipeline.

12.3 Determination of Shipper's Allocable Share of IPL (NW)'s Actual Full Cost of Service

12.3.1 Evidence of the Applicant. Although the Applicant stated that the pipeline is to serve a single oil field and a single shipper, a number of provisions in the agreement have been written to accommodate more than one shipper. One such provision, which is perhaps the most significant, is the determination of a shipper's allocable share of IPL (NW)'s actual full cost of service.

This procedure is described in section 8(b) of schedule A to the agreement and reads as follows:

> The shipper's allocable share of IPL (NW)'s actual full cost of service which shall be determined by multiplying such full cost of service by a fraction, the numerator of which is the volume of petroleum delivered by IPL (NW) to that shipper during the operating year and the denominator of which is the aggregate of volumes of petroleum delivered by IPL (NW) to all shippers during such operating year.

The Applicant stated under cross-examination that it had not discussed the agreement, nor the terms and conditions thereof, with any potential shippers other than Imperial.

12.3.2 Views of the Board. One matter of concern to the Board in relation to section 8(b) is that a shipper's actual share of the cost of service at year end could be considerably different from that projected at the beginning of the year, by virtue of the fact that a shipper's share of the actual cost of service for an operating year depends not only on its own performance, but also on the actions of all other shippers on the pipeline.

Since these provisions have not been discussed with potential shippers and since the present parties are in agreement, the Board would accept these as they are written until such time as additional shippers indicate a desire to use the pipeline and are in a position to express their views on these matters.

12.4 Operating Expenses

12.4.1 Evidence of the Applicant. The Norman Wells Pipeline Agreement stipulates that there would be a provisional toll based upon estimates of volumes and cost of service for a given year. Under cross-examination, the Applicant indicated that it had contemplated that the Board would have to approve the interim tariff (that is, the provisional toll), thereby approving the operating expense budget.

12.4.2 Views of the Board. The Board would require the Applicant to submit for review and approval its estimate of the full cost of service and the provisional toll prior to the beginning of each operating year.

However, since the Board is not convinced that the proposed system would provide sufficient control of actual operating costs, it is of the view that there must be a mechanism in place which would ensure that no operating expenses in excess of budgeted amounts would be included in the actual full cost of service until such amounts had been approved by the Board. Therefore, the Board would require that any operating expenses in excess of the approved budget not be included in IPL (NW)'s actual full cost of service until such amounts had been approved by the Board.

12.5 Management Agreement and Allocation of Common Costs Between IPL and IPL (NW)

12.5.1 Evidence of the Applicant. Under cross-examination, the Applicant stated that the management agreement between IPL and IPL (NW) had been developed in concept, but would not be finalized prior to the issuance of any certificate the Board might be prepared to grant. This agreement would include provisions relating to the allocation of common costs between IPL and IPL (NW).

The Applicant stated that the "Norman Wells Pipeline Agreement" provided Imperial with a right to review and comment on the terms of the management agreement prior to its execution. In addition, the Applicant stated that it would be agreeable to submitting the agreement to the Board for its approval.

12.5.2 Views of the Board. The Board would require the Applicant to submit the executed management agreement for Board approval.

12.6 Rules and Regulations Governing the Transportation of Petroleum

12.6.1 Evidence of the Applicant. The Applicant stated that the rules and regulations governing the transportation of petroleum in its pipeline were substantially the same as the rules and regulations which at present apply to the transportation of crude oil and natural gas liquids through the pipeline system of IPL.

12.6.2 Views of the Board. The Board finds these rules and regulations as they apply to IPL (NW) acceptable, but recognizes that minor revisions might be required should additional shippers wish to transport oil through the proposed pipeline.

12.7 Extended Outage

12.7.1 Evidence of the Applicant. Included in the tariff is a provision whereby a rebate of a shipper's proportionate share of the return on equity would be triggered by an interruption in service, provided that the interruption was caused by negligent acts of IPL (NW) or its employees and was of more than 60 days duration. The Applicant was questioned as to why this rebate did not also include the income taxes associated

with the reduced return on equity of the company. The Applicant's response was that the rebate of the associated income taxes would occur automatically as a result of proper accounting procedures.

12.7.2 Views of the Board. While the Board understands that income taxes would be reduced as a matter of course from a reduced return on equity, the Board does not accept the view that the rebate to the shippers would automatically reflect the reduced income taxes which would flow from a lower return. Therefore, the Board would require that the extended outage provision be amended to include associated income taxes when calculating the credit to a shipper's cost of service resulting from an extended outage.

CHAPTER 13
PUBLIC INTEREST, POLICY AND OTHER MATTERS

13.1 Evidence of the Applicant

The Applicant stated that the proposed pipeline project would bring a significant new source of domestic crude oil supply to Canadian domestic markets, resulting in substantial benefits to both the regional and national public interests. It was the Applicant's position that, although the throughput volumes were in the order of 3975 m^3/d and represented only approximately one percent of the total Canadian requirement, they represent approximately seven percent of Canada's daily imported volumes when compared to the average daily imports of foreign crude oil into Canada. The net result would be to reduce the burden on all Canadian taxpayers as equivalent volumes of foreign crude oil imported at world prices were displaced. The Applicant stated that as soon as the project came onstream this reduction would equate to a saving of approximately $1 million per day in foreign exchange payments. The Applicant also stated that the throughput volume of 3975 m^3/d from the Norman Wells project represented 20 percent of the volume of synthetic crude oil produced in one tarsands plant with a 19 875 m^3/d capacity.

The Applicant stated in its final argument that the project would also have a significant conservation component since it would increase the ultimate recovery of crude oil from the Norman Wells formations from 17 to 42 percent by using waterflood techniques, and would eliminate the flaring of refinery by-products and natural gas liquids. Esso Resources testified that with this project and the associated use of waterflooding there would be more supplies available for the territories than without it, inasmuch as the producibility of the field would be at a higher level for a longer period of time than it would be without it. Esso Resources further testified that, for economic reasons, it did not propose to increase the annual capacity of the existing refinery.

The Applicant testified that, because of the level of Canadian content in all capital expenditures, both for construction and operation of the project, substantial benefits would accrue to Canada. Foster Research, in conducting a cost-benefit analysis for the Applicant, estimated that there would be a net social benefit to Canada of $1.4 billion in 1979 constant dollars discounted at 10 percent over the life of the project. This benefit, according to the Applicant, would include substantial savings in oil import compensation payments, direct and indirect employment generated by the combined projects, and tax revenues and royalties paid to the federal and provincial governments. It also included benefits resulting from the activity generated in various sections of the Canadian economy from the supply of equipment, materials and services that would be required by the combined projects.

The volumes of crude oil to be transported by the Applicant for ultimate delivery to domestic markets would make a positive contribution to the security of energy supply to those markets at a time when conventional crude oil production in western Canada was declining. Moreover, in final argument the Applicant stated that the volumes to be transported through the proposed pipeline would increase the utilization of existing connecting pipelines and therefore would increase the economic efficiency of operation of such pipelines to the benefit of Canadian consumers generally.

Regarding socio-economic benefits associated with the project, the Applicant submitted, as part of its application, a socio-economic policy statement and action plan together with major policies and commitments that would be implemented to maximize the anticipated benefits to Canadians. The Applicant stated that a number of programs would be instituted to maximize opportunities for northern residents, including a training and employment program. A northern business opportunities plan would also be developed to ensure that northern communities and northern businesses are afforded a preference when bidding on business opportunities associated

with the project. The net result was that through these business opportunities the project would make a substantial contribution to the economic self-sufficiency of the North. In addition, the Applicant stated that during the peak construction period season of 1981-82 approximately 1,200 workers would be employed on pipeline construction, construction of permanent facilities, and supporting services, with special emphasis being given to the employment of northern residents. The Applicant estimated that the average annual operating expenditures for the pipeline over the first five years would be $14.3 million and that taxes to be paid to all levels of government would exceed $175 million in the first ten years of operation.

As for regulatory requirements, the Applicant stated that it had complied with all of the Board's requirements, including the National Energy Board Act, the Oil Pipeline Regulations and environmental requirements contained in Part VI of the Schedule of the Rules of Practice and Procedure. Regarding the recommendations of the Berger Commission, the Applicant stated under cross-examination that these recommendations were made with respect to a major natural gas pipeline development originating in Alaska and crossing through Canada to serve markets in the United States. Compared with the Norman Wells project, the Applicant stated that its proposal was a completely different project, in a completely different time frame, of a completely different scale, and with different priorities. Because the line would be buried and would operate at ambient temperature, it would have less of an environmental impact than that associated with the northern gas pipeline project. It was the Applicant's opinion that the Berger report dealt mostly with the sensitive areas of the northern Yukon and Mackenzie Delta and only partly with the Mackenzie Valley. The Applicant stated that the Norman Wells project would cover only approximately 50 percent of the route of the Canadian Arctic Gas Pipe Line proposal and would be

located in the area of the MacKenzie Valley that has been the subject of previous development and therefore relatively well studied.

Under cross-examination by CARC, the Applicant stated that, should a commercial oil discovery be made along the proposed route, the Applicant would at the time make the necessary application to the Board for an expanded oil transportation system, since it would improve the economics of the overall project. When asked if it was the Applicant's intention to abandon the Norman Wells project, it responded in the negative. The Applicant stated that, after the amortization of the project in 20 to 25 years, IPL (NW) would not abandon the project if there were oil available.

CARC further asked whether the Applicant had given consideration to using the Norman Wells pipeline facilities to move natural gas liquids from the Beaufort Sea. The Applicant responded that these facilities could be used; however, no studies had been undertaken on this subject. Should threshold volumes be established in the delta, the Applicant stated that it would then consider this alternative.

With respect to the question of ownership of oil at Norman Wells and the possibility of conflict of interest because the Government of Canada was part owner of the oil, the Applicant in response to questions posed by CJL stated that no such situation existed. Imperial would be a shipper on this line and IPL (NW) had an agreement with Imperial and, as a public carrier, has had no direct dealings with the federal government.

13.2 Evidence of Intervenors

In the direct evidence filed with the Board by CJL, questions arose as to whether or not an essential element in the decision of the Board to issue a Certificate of Public Convenience and Necessity was to determine the kind of native claims settlement that would contribute to meeting the "public convenience and necessity" objective.

CJL further suggested that the Board's first priority in determining "public convenience and necessity" was to have a

clear idea of what constitutes such convenience and necessity. It was CJL's opinion that public convenience and necessity requires the Board to decide whether the project would contribute to the well-being and the quality of life of the people of the North most affected by the project and all Canadians.

CJL further stated in its evidence that, as a means to this end, a decision-making framework was needed weighing equally all of the impacts of the project, which would lead to the determination of whether, on balance, the project would produce net benefits.

CHAPTER 14
DISPOSITION

14.1 Introduction

Throughout the previous chapters of this report, the Board has set out a summary of the evidence, submissions and arguments of the Applicant and intervenors, and has expressed its own views and conclusions on a wide variety of issues that were raised at the public hearing of the application by Interprovincial Pipe Line (NW) Ltd. for a Certificate of Public Convenience and Necessity to construct and operate an oil pipeline extending from Norman Wells in the Northwest Territories to Zama, in the Province of Alberta, and for an order establishing the form and content of the rates, tolls and tariffs for the transportation service the company would perform.

The Board has carefully considered all of the evidence, submissions and arguments made before it concerning the application for a Certificate of Public Convenience and Necessity under Part III of the Act and for a Tariff Order under Part IV.

14.2 Application for a Certificate of Public Convenience and Necessity under Part III of the National Energy Board Act.

When considering an application for a Certificate of Public Convenience and Necessity, the Board is required to take into account all such matters as to it appear to be relevant, and without limiting the generality of the foregoing, the Board may have regard to the following:

(a) the availability of oil to the pipeline;

(b) the existence of markets, actual or potential;

(c) the economic feasibility of the pipeline;

(d) the financial responsibility and financial structure of the Applicant, the methods of financing the line and the extent to which Canadians will have an opportunity of participating in the financing, engineering and construction of the line; and

(e) any public interest that in the Board's opinion may be affected by the granting or the refusing of the application.

The Board has taken into account all matters that appeared to it to be relevant in considering the application for a certificate and in reaching its decision in this matter. The Board is satisfied that the pipeline facilities applied for by IPL (NW) are and will be required by the present and future public convenience and necessity.

As to the availability of crude oil for the proposed pipeline facilities, the Board finds that the Applicant has established that there will be an adequate supply through the Norman Wells oil field development project. While the Board's forecast of crude oil production is slightly lower than that forecast by the Applicant in the early years and slightly higher during the later stage, the Board finds that both forecasts are within the margin of error that could be assigned to either forecast methodology used and is satisfied that the development proposal is realistic and the production forecast reasonable.

With respect to markets to be served by the pipeline, because it is expected that the production of Canadian crude, both conventional and synthetic, will fall short of meeting Canada's long-term demand requirements, the Board finds it reasonable to assume that a ready market will be available in Canada for the light crude oil and for the NGL produced as a by-product of Norman Wells crude oil production. Moreover, the Board finds that under the prevailing circumstances the volumes of crude oil to be transported by the proposed pipeline for ultimate delivery to domestic markets will make a positive contribution to the security of energy supply.

Although it was argued that the relatively small volumes of oil to be produced at Norman Wells could be saved if efforts were directed at conservation, the Board finds that a

market is expected to be available regardless of steps which may be taken to conserve oil. The Board considers efforts towards conservation of oil necessary, and in this regard the Board sees advantages in the Norman Wells oil field development project, because of which there will be available sizeable additional volumes of NGL and heavy distillates which would otherwise be flared. Furthermore the reduction of the gas-oil ratios under the proposed expanded waterflood scheme should lead to a substantial increase in the ultimate recovery level and therefore in the production of crude oil.

The Board has examined the evidence adduced on right-of-way matters and is satisfied that IPL (NW)'s proposed facilities can be built with minimal interference with existing or potential land uses, including hunting and trapping, in light of the procedures proposed and to be undertaken in this regard. The Board is generally satisfied with the location of the route for the proposed pipeline facilities although it recognizes the possible need for relocation of pumping station sites during final design.

After a careful review of the evidence, the Board concludes that the project is feasible from an engineering point of view. The Board agrees with the selection of a conventional buried mode design for the pipeline and the Board finds satisfactory both the selection of a 323.9 mm. diameter pipeline and the proposed pumping station configurations. The Board recognizes that before completion of final design, further information would become available from additional geotechnical and other studies, which information should be used for final design purposes.

In Chapter 5 of this report, the Board has expressed its views with regard to the Applicant's geotechnical and geothermal assessments, thaw settlement and frost heave analyses, slope stability and river crossing designs. On the basis of the evidence, the Board is convinced that the project is feasible from a geotechnical and geothermal point of view.

However, the Board is of the view that a complete and comprehensive terrain investigation is fundamental to an accurate geotechnical and geothermal assessment of the proposed pipeline route. The Board recognizes the preliminary nature of the geotechnical and geothermal assessments performed by the Applicant but is satisfied with the analyses completed at this stage. The Board agrees with the Applicant that further geotechnical and geothermal assessments, through the analysis of site-specific subsurface investigations, should be an initial step in the formulation of final design.

Although the Board is generally satisfied with the treatment given by the Applicant to geotechnical and geothermal design at this stage, the Board has expressed, in Chapter 5 of this report, several concerns in areas where it feels that further investigations are required to ensure an optimum design of the system from a geotechnical and geothermal point of view. Accordingly, there should be conditions in the certificate requiring that appropriate steps be taken to provide the best information possible for purposes of final design of the pipeline system.

The Board has determined that the proposed construction procedures are within the limits of conventionally available pipeline construction techniques and is confident that the installation of the facilities is technically feasible.

The question of operation and maintenance of the proposed pipeline was examined at the hearing. The Board is of the view that detailed and well-documented operation and maintenance procedures are essential for the proper operation of a pipeline system. From the evidence, the Board is confident that IPL (NW) has available to it the experience and expertise to implement satisfactory operational procedures for the proposed pipeline system. Because experience related to the repair and maintenance of pipelines in the North is

limited, the Board accepts that IPL (NW) should use experience gained during the construction phase of the project to develop maintenance procedures, which shall be submitted for Board approval prior to leave to open being granted.

With respect to the total capital cost estimate of approximately $360,000,000 submitted by IPL (NW) for the facilities for which certification is sought, the Board is satisfied with the analyses that IPL (NW) has conducted with respect to Canadian content and finds the estimated level of Canadian content to be reasonable.

On the basis of the evidence adduced on environmental matters, the Board is satisfied that the pipeline facilities can be constructed in an environmentally acceptable manner.

In Chapter 7 of this report, the Board has expressed its views on the environmental issues raised at the public hearing, including the questions of construction planning, terrain matters, use of cut lines, borrow resources, river crossings, reclamation plans, archaeological and historical resources, wildlife resources, aquatic habitat and fish resources, raptors, environmental orientation programs, construction inspection, environmental monitoring and surveillance, contingency plans, etc.

The Board has received numerous undertakings from the Applicant to provide additional detailed information based on additional studies and further design work. In Chapter 7, the Board has stated its concerns relating to environmental matters and has noted that a considerable number of additional site-specific studies are required in many areas to establish prevailing environmental conditions, develop mitigative measures and establish maintenance and rehabilitation procedures. Because the Board feels that intervenors of record can make a valuable contribution in assessing some of the information to be filed, the Board has decided to provide an opportunity to intervenors of record to review and comment on

the Applicant's study reports, programs, measures and procedures. In Chapter 7 of this report, the Board has explained the procedure it will follow in its approval process of the environmental studies; instead of repeating it here, reference is made to section 7.17.3.

The Board has given careful consideration to the evidence before it with respect to financing matters. Following a thorough examination of both the financial responsibility and financial structure of the Applicant, the Board finds the project financing plan as outlined by the Applicant to be acceptable. However, the Board, as a condition of the certificate, will require IPL (NW) to file prior to commencement of construction, information showing that appropriate arrangements have been made for financing the pipeline.

A major part of the hearing was devoted to the hearing of evidence on regional socio-economic matters. In light of the evidence presented by the Applicant and the views expressed by intervenors, the Board has assessed the potential facilities in terms of regional feasibility and regional desirability. The Board has determined that, provided that the policies, programs and commitments given in the course of hearing the application are implemented and provided that certain additional measures are taken, the proposed project is feasible and could be built without unduly taxing the infrastructure, services and facilities of the impact area. As to regional socio-economic desirability, the Board finds that the proposed pipeline project may not provide the region with a net positive benefit but rather that its modest potential benefits and modest potential liabilities would balance out, at least in the short-term. The Board has determined that conditions should be attached to the certificate to provide for certain measures to be taken by the Applicant with respect to

the regional socio-economic impacts of the pipeline construction and operation. As mentioned in Chapter 8, socio-economic plans and programs to be filed by the Applicant will be subject to an approval procedure similar to that discussed above with respect to environmental studies.

The Board has heard a considerable amount of evidence on the question of land claims negotiations between the native people and the federal government in relation to the proposed pipeline project. The Board recognizes the importance of the native claims but, on the basis of the evidence before it, it is not convinced that approval of the proposed pipeline project would in fact prejudice the settlement of native claims.

The issue of economic viability of the IPL (NW) proposed pipeline system focused on the ability of Esso Resources to provide sufficient volumes of crude oil to the Applicant's system. After conducting its own assessment of the economic viability of Esso Resources' proposed expansion of Norman Wells production, on the basis of the evidence adduced, the Board has concluded that the expansion of the Norman Wells producing capability is economically viable under any set of circumstances which could be reasonably anticipated.

The Board also assessed the net economic benefits to Canada from developing the Norman Wells oil reserves and marketing the products in eastern Canada. From the evidence presented and the views expressed on the Applicant's cost-benefit study, the Board has determined that there will be a net economic benefit to Canada from the IPL (NW) pipeline project, and this under as wide a range of scenarios as could reasonably be anticipated with respect to discount rates, oil price and production volumes.

Having regard to the foregoing considerations, findings, and conclusions, and having taken into account all

matters that appear to it to be relevant, the Board, being satisfied that the pipeline facilities applied for by Interprovincial Pipe Line (NW) Ltd. are and will be required by the present and future public convenience and necessity, is prepared to issue to IPL (NW) a Certificate of Public Convenience and Necessity in respect of the pipeline facilities which were the subject of this application, upon the terms and conditions set out in Appendix I, subject to the approval of the Governor in Council.

* * * * * * * *

All of which is respectfully submitted.

R.F. Brooks,
Presiding Member

J. Farmer,
Member

J.L. Trudel,
Member

14.3 Application for an Order Respecting the Form and Content of the Tariff for the Transportation of Petroleum from Norman Wells to Zama under Part IV of the National Energy Board Act.

Throughout Chapter 12, the Board has recorded a number of decisions with respect to the application by IPL (NW) for approval of the form and content of the tariff for the transportation of petroleum from Norman Wells to Zama through the Applicant's proposed oil pipeline, which tariff is incorporated in the "Norman Wells Pipe Line Agreement." Following from these decisions, the Board accepts

(1) the Applicant's proposed method of regulation, and the form and content of the proposed "full cost of service" tariff as contained in the "Norman Wells Pipe Line Agreement," including the 16 percent return on equity referred to in Article 4.6 of Schedule A to the Agreement, and

(2) the Applicant's proposed Rules and Regulations contained in Schedule B to the Norman Wells Pipe Line Agreement which would apply to the transportation of petroleum through the oil pipeline,

all subject to the following requirements and conditions:

(a) Paragraph (c) of the definition of "Equity" in Article 1.1 of the "Norman Wells Pipe Line Agreement" shall be amended by inserting the words "the unamortized balance of" at the beginning of each of items (ii) and (iii) thereof;

(b) IPL (NW) shall submit to the Board for review and approval, at least two months prior to the commencement of each operating year, its estimate of the full cost of service for the next operating year and the computed provisional toll to be in effect for the next operating year, arrived at in accordance with Article 5.0 of Schedule A to the "Norman Wells Pipe Line Agreement";

(c) IPL (NW) shall submit to the Board for review and approval, at the latest within 30 days after the end of each operating year, the amounts of any operating expenses in excess of the estimate of the full cost of service approved by the Board pursuant to paragraph (b) hereof and IPL (NW) shall not include in its actual cost of service any such amounts until such time as they have been approved by the Board;

(d) any "Management Agreement" entered into by Interprovincial Pipeline Limited and IPL (NW), pursuant to Article 18.3 of the "Norman Wells Pipe Line Agreement," including provisions for the allocation of common costs between Interprovincial Pipeline Limited and IPL (NW), shall be submitted to the Board for its approval upon execution of such agreement; and

(e) the "Extended Outage" provision contained in Article 10.0 of Schedule A to the "Norman Wells Pipe Line Agreement" shall be amended to include the income taxes associated with the reduced return on equity of the company which would result if this provision were to apply.

In indicating its acceptance of the method of regulation, the form and content of the "full cost of service" tariff, and the Rules and Regulations, the Board wishes to stress that

(f) the method of regulation and the form and content of the tariff, including the provisions of the Norman Wells Pipe Line Agreement that have been written so as to accommodate more than one shipper, may be reviewed at any time that it becomes evident that shipper(s) other than Imperial intend to use the pipeline; and

(g) the Rules and Regulations contained in Schedule B to the "Norman Wells Pipe Line Agreement" may be reviewed should shipper(s) other than Imperial indicate a desire to use the pipeline.

The foregoing, together with Chapter 12 and Board Order No. TO-2-81, shown as Appendix II hereto, set forth our Reasons for Decision and our decision in the matter of an application by IPL (NW) for an order respecting the form and content of the tariff for the transportation of petroleum from Norman Wells to Zama under Part IV of the National Energy Board Act.

R.F. Brooks,
Member

J. Farmer,
Member

J.L. Trudel,
Member

TERMS AND CONDITIONS OF CERTIFICATE

1. The pipeline facilities to be constructed pursuant to this certificate shall be the property of and shall be operated by Interprovincial (NW).

2. Interprovincial (NW) shall, unless otherwise authorized or ordered by the Board, cause the facilities in respect of which this certificate is issued to be designed, manufactured, located, constructed and installed in accordance with specifications, plans, drawings and procedures approved pursuant to the terms and conditions contained herein, and the requirements of the National Energy Board Oil Pipeline Regulations (SOR/78-746).

3. Prior to construction, in these terms and conditions defined as prior to any site preparation, clearing, access road construction, or borrow pit development, Interprovincial (NW) shall not, unless otherwise authorized by the Board, cause any disturbance to the terrain along the pipeline route other than that which is necessary to carry out the field studies and surveys referred to in these terms and conditions.

4. Interprovincial (NW) shall, unless otherwise authorized or ordered by the Board, implement or cause to be implemented all the policies, practices and procedures for the protection of the environment included in its environmental reports and as otherwise adduced in its evidence before the Board, and those detailed in the further submissions referred to in conditions 5 and 13 herein.

5. Interprovincial (NW) shall, within two months of the issuance of this certificate, or on such later date as may be set by the Board, submit for the approval of the Board a schedule for the filing of those environmental and socio-economic studies, programs, practices, plans and procedures it undertook to carry out or develop, including those required by these terms and

conditions, and shall proceed to submit the material in accordance with the approved schedule, unless otherwise authorized by the Board.

6. Interprovincial (NW) shall, concurrently with the submission to the Board of the schedule referred to in condition 5, serve a copy of the said schedule upon every party of record in the hearing.

7. (1) Concurrently with the filing with the Board of each of the socio-economic submissions listed in the schedule referred to in condition 5 herein, Interprovincial (NW) shall serve notice on each of the parties of record in the hearing of the filing of the submission, and shall forthwith, on receipt of a request in writing from any of the said parties, serve a copy of the submission on that party. Interprovincial (NW) may apply to the Board for relief from the obligation of serving any of the said submissions on any or all parties, setting forth its reasons for making such application, but in such a case the notice required by this condition to be served on parties of record shall set out the reasons for the application.

(2) Parties upon whom a copy of any submission has been served pursuant to subcondition (1) may within 30 days of the receipt of the submission submit suggestions respecting the submission to Interprovincial (NW) and to the Board. Interprovincial (NW) shall, as soon as possible, submit to the Board and to the party from whom a suggestion was received, a response indicating which of that party's suggestions it is prepared to incorporate into the submission, and its reasons for not incorporating any other of that party's suggestions.

(3) Where applicable, Interprovincial (NW) shall file with the Board a revised submission incorporating those suggestions of parties of record which it has agreed to incorporate pursuant to subcondition (2).

(4) The Board may issue an order signifying its satisfaction with any submission or revised submission.

8. (1) Concurrently with the filing with the Board of each of the environmental submissions listed in the schedule referred to in condition 5 herein, Interprovincial (NW) shall serve notice on each of the parties of record in the hearing of the filing of the submission, and shall forthwith, on receipt of a request in writing from any of the said parties, serve a copy of the submission on that party. Interprovincial (NW) may apply to the Board for relief from the obligation of serving any of the said submissions on any or all parties, setting forth its reasons for making such application, but in such a case the notice required by this condition to be served on parties of record shall set out the reasons for the application.

(2) Parties upon whom a copy of any submission has been served in accordance with subcondition (1) may within 30 days of the receipt of the submission send suggestions respecting the submission to Interprovincial (NW), and to the Board.

(3) Interprovincial (NW) shall, in the preparation of the programs, specifications and manuals referred to in conditions 14 and 15 herein, incorporate the suggestions received from parties of record that it accepts, and where Interprovincial (NW) is unwilling to incorporate any such suggestions, it shall provide an explanation in writing to the party from whom the suggestion was received, and to the Board.

(4) Concurrent with the filing with the Board of each of the programs, specifications, and manuals required by conditions 14 and 15 herein, Interprovincial (NW) shall serve a copy of the program, specification, or manual on each of the parties from whom suggestions were received pursuant to subcondition (2). Interprovincial (NW) may apply to the Board for relief from the obligation of serving any of the said programs, specifications, or manuals on any or all parties, setting forth its reasons for making such application, but in such a case, Interprovincial (NW), shall serve a notice on each of the said parties setting forth the reasons for such application.

(5) Parties upon whom a copy of any program, specification, or manual has been served in accordance with subcondition (4) may

submit comments to the Board respecting such program, specification, or manual within a time and in a manner to be directed by the Board at the time of the filing of such program, specification, or manual, and Interprovincial (NW) may reply to such comments within a time and in a manner to be directed by the Board.

(6) The Board may issue an order signifying its approval of any program, specification, or manual.

9. The plans, profiles and books of reference, to be filed pursuant to Section 29 of the Act, shall be based on field surveys of the entire route and shall indicate
   a) all permanent and temporary rights-of-way,
   b) the locations of pumping station sites, and
   c) the locations of any mining claims.

10. Interprovincial (NW) shall, prior to approval by the Board of plans, profiles and books of reference, submit to the Board
   a) copies of all signed easement agreements, and
   b) terrain maps, satisfactory to the Board and similar to those filed as Exhibit 19A in the hearing, covering those parts of the pipeline route including related facilities and access roads for which such maps have not already been submitted.

11. Interprovincial (NW) shall, prior to construction, submit
   a) information satisfactory to the Board setting out the findings of field tests, experiments and analyses in support of the final design of the pipeline system, and
   b) for the approval of the Board, the final design for each portion of the pipeline system.

12. Interprovincial (NW) shall, prior to construction, submit to the Board
   a) documents to demonstrate to the satisfaction of the Board that the Development Plan for the Norman Wells field has received the necessary regulatory approvals, and

b) information showing to the satisfaction of the Board that appropriate arrangements have been made for financing the pipeline.

13. Interprovincial (NW) shall, prior to construction, submit reports satisfactory to the Board providing
    a) an environmental assessment of the development, operation, abandonment and rehabilitation of all borrow pits including the impact on terrain, wildlife and aquatic resources resulting from borrow pit activities, associated road construction and transport of borrow and associated materials,
    b) mitigative measures based on studies of fish resources wintering in the vicinity of water crossings scheduled for winter construction,
    c) results of studies which identify species of raptors occupying nest sites within 3.2 km (2 miles) of field construction activities, which report shall contain site-specific mitigative measures,
    d) the identification and assessment of areas sensitive to terrain degradation, and
    e) results and supporting data from field investigations for the evaluation of
        i) slopes which may become unstable,
        ii) water crossings and the approaches thereto, and
        iii) interfaces of frozen and unfrozen soil where special designs may be required.

14. Interprovincial (NW) shall, prior to construction, develop and submit programs satisfactory to the Board for
    a) the environmental education of inspection and construction staff, and
    b) construction and environmental inspection, including organization and reporting structure, and staff qualifications, training, authority, responsibilities and functions.

15. Interprovincial (NW) shall, prior to construction, submit for the approval of the Board
    a) construction contract specifications which shall include at least
        i) the program for preserving the stability of slopes,
        ii) the design and construction methods for water crossings,
        iii) the appropriate timing and construction methods for the crossings of the Great Bear and Mackenzie Rivers, and
    b) an environmental procedures manual which shall include at least
        i) monitoring procedures during construction,
        ii) measures for mitigating terrain damage,
        iii) revegetation programs,
        iv) procedures for handling and storage of fuels, lubricants and toxic chemicals, and the contingency plans in the event of spills,
        v) all other measures developed as a result of recommendations in the environmental reports submitted during the hearing and pursuant to condition 5 and 13 herein, and
        vi) an identification of those matters listed in part (b) of this condition which will form part of the construction contract specifications.

16. Interprovincial (NW) shall, prior to construction, develop and submit plans and procedures satisfactory to the Board for project cost control.

17. Interprovincial (NW) shall submit for the approval of the Board
    a) three to six months prior to construction, a current construction schedule, and
    b) during construction, any revisions to the construction schedule and, where necessary, corresponding changes to the applicable environmental mitigative measures.

18. Interprovincial (NW) shall, during the construction period, unless otherwise authorized by the Board, submit each month

construction reports satisfactory to the Board which detail the progress and current status of the project.

19. Interprovincial (NW) shall, unless otherwise authorized by the Board, within three months after the completion of the first winter of construction, submit
    a) for the approval of the Board, a reclamation plan for the right-of-way, and
    b) a reclamation plan satisfactory to the Board for access roads, borrow pits and construction sites.

20. Further to the requirements of Part VII of the Oil Pipeline Regulations (SOR/78-746), Interprovincial (NW) shall, prior to leave-to-open being granted, submit for the approval of the Board
    a) a maintenance manual which shall include a section dealing with the special problems of operating and maintaining this northern pipeline system,
    b) an emergency procedures manual, and
    c) contingency plans for hydrocarbon loss from the pipeline and related facilities including procedures for the detection of and recovery of hydrocarbons from water bodies during periods of freeze-up and break-up.

21. Interprovincial (NW) shall, prior to leave-to-open being granted, submit for the approval of the Board a complete procedure and schedule for monitoring
    a) the condition of the right-of-way with respect to thaw settlement, frost heave, and the adequacy of drainage and erosion control measures,
    b) the radius of curvature of the pipe at sites of soil movement where critical pipe stresses may be exceeded,
    c) the condition of the slopes along the right-of-way, and
    d) the condition of river crossings.

22. Interprovincial (NW) shall, unless otherwise authorized by the Board, by 31 October of each year during the construction and

operation of the pipeline, submit a report satisfactory to the Board describing the results of monitoring

a) the effects of pipeline construction and operation on the environment,
b) the condition of the right-of-way and the pipeline, and
c) the condition of river crossings and approaches, and slopes along the right-of-way.

23. Interprovincial (NW) shall, within twelve months after start-up of operations, or on such later date as may be set by the Board, submit for the approval of the Board a report detailing the actions taken or to be taken to mitigate long-term environmental effects of construction and operation of the pipeline system and evaluating the adequacy of the environmental policies, practices and procedures used during construction and operation.

24. Interprovincial (NW) shall, unless otherwise authorized by the Board, within six months following the end of the first year of operation of the pipeline system, submit a report satisfactory to the Board on the actual socio-economic impact of the project, including the development of the Norman Wells field, during the construction period and the first year of operation.

25. Interprovincial (NW) shall, unless otherwise authorized by the Board, at the end of the first and third years of operation of the pipeline system, submit to the Board aerial photographs of the entire route taken at a time and at a scale satisfactory to the Board, and an analysis of ground conditions on the right-of-way as shown in the photographs.

NATIONAL ENERGY BOARD

CANADA

OFFICE NATIONAL DE L'ÉNERGIE

ORDER NO. TO-2-81

IN THE MATTER OF the National Energy Board Act and the Regulations made thereunder; and

IN THE MATTER OF an application by Interprovincial Pipe Line (NW) Ltd. (hereinafter referred to as "Interprovincial (NW)") for an Order under Part IV of the National Energy Board Act respecting rates, tolls and tariffs, filed with the Board under File No. 1755-J1-42.

B E F O R E:

R.F. Brooks Vice-Chairman	)	On
J. Farmer Associate Vice-Chairman	)	the 23rd day of
J.L. Trudel Member	)	March, 1981

UPON an application by Interprovincial (NW) dated the 14th day of March, 1980, under Part III of the National Energy Board Act for a Certificate of Public Convenience and Necessity authorizing the construction and operation of an oil pipeline from Norman Wells in the Northwest Territories to Zama in the Province of Alberta, and under Part IV of the National Energy Board Act for an Order establishing the form and content of the rates, tolls and tariffs of the said oil pipeline;

AND UPON the Board having heard evidence and submissions relating to the said application at a public hearing which commenced on the 7th day of October, 1980;

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AND UPON the Board having considered the evidence and submissions relating to the application for an Order under Part IV of the National Energy Board Act;

THEREFORE IT IS DECLARED THAT:

1. Under sections 11 and 50 of the National Energy Board Act,

(1) the method of regulation, and the form and content of the "full cost of service" tariff contained in the Norman Wells Pipe Line Agreement between Imperial Oil Limited, Interprovincial Pipe Line (NW) Ltd. and Interprovincial Pipe Line Limited dated 1 January 1980 (the "Norman Wells Pipe Line Agreement"), including the 16 percent return on equity referred to in Article 4.6 of Schedule A thereto, and

(2) the Rules and Regulations contained in Schedule B to the Norman Wells Pipe Line Agreement to apply to the transportation of petroleum through the Interprovincial (NW) oil pipeline,

are hereby approved, all subject to the following requirements and conditions:

(a) Paragraph (c) of the definition of "Equity" in Article 1.1 of the Norman Wells Pipe Line Agreement shall be amended by inserting the words "the unamortized balance of" at the beginning of each of items (ii) and (iii) thereof;

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(b) Interprovincial (NW) shall submit to the Board for review and approval, at least two months prior to the commencement of each operating year, its estimate of the full cost of service for the next operating year and the computed provisional toll to be in effect for the next operating year, arrived at in accordance with Article 5.0 of Schedule A to the Norman Wells Pipe Line Agreement;

(c) Interprovincial (NW) shall submit to the Board for review and approval, at the latest within 30 days after the end of each operating year, the amounts of any operating expenses which exceed the amounts contained in the estimate of the full cost of service approved by the Board pursuant to paragraph (b) hereof and Interprovincial (NW) shall not include in its actual cost of service any such amounts until such time as they have been approved by the Board;

(d) any management agreement entered into by Interprovincial Pipe Line Limited and Interprovincial (NW), pursuant to Article 18.3 of the Norman Wells Pipe Line Agreement, including provisions for the allocation of common costs between Interprovincial Pipe Line Limited and Interprovincial (NW), shall be submitted to the Board for its approval upon execution of such agreement; and

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(e) the "Extended Outage" provision contained in Article 10.0 of Schedule A to the Norman Wells Pipe Line Agreement shall be amended to include the reduction in income taxes associated with the reduced return on equity of the company which would result if this provision were to apply.

IT IS FURTHER DECLARED THAT:

2. Notwithstanding the provisions contained in paragraph 1 of this Order,

(a) the method of regulation and the form and content of the tariff, including the provisions of the Norman Wells Pipe Line Agreement that have been written so as to accommodate more than one shipper, may be reviewed at any time that it becomes evident that any shipper other than Imperial Oil Limited intends to use the pipeline; and

(b) the Rules and Regulations contained in Schedule B to the Norman Wells Pipe Line Agreement may be reviewed should any shipper other than Imperial Oil Limited indicate a desire to use the pipeline.

AND IT IS ORDERED THAT:

3. The provisions contained in paragraphs 1 and 2 of this Order shall remain suspended and be of no effect until such time as a certificate is issued to Interprovincial (NW) under Part III of the National Energy Board Act, further to the application of Interprovincial (NW) dated the 14th day of March, 1980.

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DATED at the City of Ottawa, in the Province of Ontario, this 23rd day of March, 1981.

NATIONAL ENERGY BOARD

G. Yorke Slader,
Secretary.

GLOSSARY OF TECHNICAL TERMS

Active Layer. The top layer of the ground above the permafrost table which thaws annually. Active layer thickness may vary from a few centimeters to several meters.

Active Layer Detachment Slide. The mass movement of the material of the active layer along the active layer-permafrost interface.

Cut Line. A line approximately 10 m in width used for seismic surveys, winter roads etc. from which brush and trees have been removed.

Differential Settlement. The downward displacement of one point in a structure relative to another, resulting from a localized loss of soil support. Settlements of this nature are of particular concern because of the stresses which can be induced into a structure.

Five - Spot Production Pattern. The spacing and pattern of wells in a secondary recovery or pressure maintenance project. A common injection pattern includes a five-spot pattern where a production well is located in the centre of a square which is formed by four injection wells.

Frost Bulb. A bulb-shaped intrusion of the permafrost table into the active layer resulting from localized chilling caused by natural or man-made events. The bulb will grow until a new thermal equilibrium is reached.

Frost Heave. Certain types of soils, under certain conditions of moisture content and in-situ density exhibit an increase in volume of the soil mass when frozen. This volume increase phenomenon, which tends to impart upward displacements to surface features or structures, is referred to as frost heaving.

Gas-Oil Ratio. A measure of the volume of gas produced with oil, expressed in cubic feet per barrel or cubic metres per cubic metre.

Heavy Distillates. The range of refined petroleum products which include heavy fuel oil, lube oils and asphalt.

High Vapour Pressure Products. A class of petroleum products associated with the production of crude oil and natural gas which exist as vapours at standard atmosphere pressure and temperature conditions but are normally transported in a pipeline as liquids. These products are sometimes referred to as natural gas liquids. Common examples of natural gas liquids are butane and propane or mixtures thereof.

Injection Well. A well in which fluids have been injected into an underground stratum to increase reservoir pressure.

Middle Distillates. The range of refined petroleum products which include kerosene, stove oil, diesel fuel and light fuel oil.

Naphtha. A mixture of hydrocarbons mostly pentanes and heavier with a maximum final boiling point of about 480°C.

Natural Gas Liquids. Natural gas liquids are those hydrocarbon components recovered from raw natural gas as liquids by processing through extraction plants or recovered from field separators, scrubbers, or other gathering facilities. These liquids include the hydrocarbon components ethane, propane, butanes and pentane plus or a combination thereof.

Original Oil-in-Place. See "Recovery".

Permafrost. A thermal condition of earth materials when their temperatures remain continuously below 0°C for more than one year.

Permeability. The measure of the ease with which fluids may move through the interconnected pores of the rock.

Porosity. The pore space or void space of a rock expressed as a fraction or percentage of the total volume of the rock.

Raptor. Birds of prey; includes eagles, falcons, hawks.

Recovery.

Original Oil-in-Place. The total calculated volume, prior to any production of crude oil within a discovered petroleum reservoir, of which only a portion is recoverable.

Primary Recovery. Crude oil recovery from a petroleum reservoir as a result of the natural energy of the reservoir moving the crude oil toward producing wells.

Secondary Recovery. The additional crude oil recovery from a petroleum reservoir obtained by supplying energy to supplement or replace the energy of primary recovery. Generally, the term refers to already technically and economically proven methods such as waterflooding, gas injection, and steam injection.

Retrogressive Thaw Flow Slide. A slide consisting of ice or ice-rich sediments and having a steep headwall, which retreats in retrogressive fashion through melting. This results in a debris flow, formed from the mixture of thawed sediment and ice, which slides down the face of the headwall to its base.

Thaw Bulb. A body of perennially thawed ground caused by localized heat transfer from a warm object at or near the surface. The thaw bulb will grow in size until a new thermal equilibrium is established. If the bulb engulfs ice-rich soils a loss of bearing capacity and thaw settlement will occur.

Thaw Sensitive Soils. Soils which lose much of their bearing capacity on thawing. Silty soils are particularly thaw sensitive.

Thaw Settlement. A settlement of the ground surface in certain soil types which results from the melting of excess ice in the soil mass and the consolidation of the thawed soil strata. As a result, the terrain surface and man-made structures experience settlements.

Thermokarst. Subsidence of the ground surface in permafrost regions producing undulations and hollows caused by the melting of ground ice.

Vegetation Mat. The surface layer of both living and dead organic matter which covers mineral soil. This layer acts as an insulating layer preventing thaw and erosion of frozen soils.

Water Breakthrough. Water breakthrough occurs when the injected water first reaches the well bore of a production well.

Waterflooding. The process of injecting water into a reservoir for the purpose of displacing oil towards a production well.

Water-Oil Ratio. A measure of the volume of water produced with oil expressed in barrels per barrel or cubic metres per cubic metre.

Workover. To perform one or more of a variety of remedial operations on a producing well to try to increase production.